THE

ELECTRICAL REVIEW.

VOL. XLIX. NOVEMBER 29, 1901. No. 1,253.

CONTENTS:

	PAGE
The London Telephone Service	869
Bills and Provisional Orders—Session 1902	871
Wireless Telegraphy in Italy	872
Current Specifications.—LXXXII.	873
Institution of Electrical Engineers (Manchester Section):—	
Mr. Wordingham's Inaugural Address	873
Legal	875
Electrical Matters at the London County Council	881
Correspondence:—	
Multiplicity of Tenders	881
10,000-Volt Shock	881
The De Beers Contracts	882
Electrical Contracting and its Abuse	882
Examination Test for Electrical Engineers	882
Horse-Power Meters	883
Coal Consumption per Unit in Power Stations	883
Poplar Union Electrical Works	883
The E.E. Vols. Christmas Gifts	883
Business Notes	884
Machine Tools at the Glasgow Exhibition (*illus.*) (*continued*)	889
Goliath Travelling Crane (*illustrated*)	891
Supply Station Accounts	898
City Notes	899
Traffic Receipts	900
Stocks and Shares	900
Share List of Electrical Companies	901
Market Quotations	902
Electric Equipment of Cranes (*illustrated*) (*concluded*) ...	903
Applications for Parliamentary Powers, Session 1901-2 ...	905
Institution of Electrical Engineers:—	
Mr. Langdon's Inaugural Address	905
The Electrical Working of Railways (*concluded*)	908
The Destructive and Lethal Effects of High Pressure Currents	909
The Silvertown Patent Connector for Electrical Testing (*illus.*)	910
Designing of Continuous Current Dynamos	911
Physical Society	912
New Patents	912
Abstracts of Published Specifications	912

THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

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THE LONDON TELEPHONE SERVICE.

IN our last issue we published the Postmaster-General's statement regarding the London telephone service, with particulars of the various rates it is proposed to charge. In accordance with the views of the most recent Parliamentary Committee on Telephones the basis of the Post Office charges is that known as the message rate. But the London telephone service hitherto has been charged for on the basis of a "flat rate," and the Post Office scheme provides for a continuance of this system for any subscriber who prefers it. There is some apparent complexity in the statement of the rates of charges, which may be more readily comprehended when it is understood that there are several Londons—the City of London, the County of London, and the London telephone area. These three Londons may be reduced to two—the County and the telephone area. On the message rate system, with a direct line, the "establishment" charge will be £5 per annum in the County and £4 per annum outside the County. For a two-party line the "establishment" charge will be £3 per annum for the whole telephone area. A ten-party line will be afforded to subscribers outside the County, and for this the establishment charge will be £2 per annum. No party lines will be permitted to subscribers connected with the Central Exchange in the City. Beyond the establishment charge, fees for each call will be paid, and these are :—One penny for each call originating and terminating within the County, and twopence for a call originating in the County and terminating outside it. For a call originating outside the County the charge is one penny if terminating on the same exchange, and twopence if terminating on any other exchange. A subscriber will be required to guarantee a minimum number of messages or pay the value of them. Thus, in addition to the establishment charge there will be a minimum message charge of £1 10s. for direct lines and £3 for party lines. The minimum message charge added to the establishment charge will make the lowest payments (assuming the subscriber to be within two miles of the exchange) for the respective classes as follows :—

Direct line in County	£6 10 0
Direct line outside County	5 10 0
Two-party line (City excepted)	6 0 0
Ten-party line outside County	5 0 0

For these payments the subscriber on the direct line will be able to make 360 1d. calls per year or, say, one a day, and the party line subscriber two per day if at 1d., but assuming that calls from outside the County will be mainly those terminating at some other exchange, and therefore chargeable at twopence, the number of calls permissible to a party line subscriber would accord with the direct line subscriber, and be one per day. Taking as a basis that 30s. per annum permits an average of one call per day, it will be seen that as soon as a direct line subscriber's calls amount to eight per day, the cost will be £17 per annum, and this is the amount charged to a subscriber

who may make an unlimited number of calls. In the case of a second line the charge is reduced to £14. The call office fee is 2d. per call within the area. There are additional charges of £1 5s. per quarter mile for any direct line subscriber whose premises are more than two miles from an exchange, and 10s. per quarter mile "for each subscriber" "where the main circuit of a party line exceeds two miles in length." Extension lines on the same premises will cost 30s. per annum if they do not exceed 110 yds. in length, and 10s. extra for each 110 yds. Extension lines connecting separate premises, £3 10s. per annum within a quarter mile, and £1 5s. extra for each additional quarter mile.

The important statement that subscribers will have the right to communicate with subscribers of the National Telephone Company concludes the notice issued by the Postmaster-General, and in the explanatory remarks it is announced that the company has agreed to charge the same rates as the Post Office.

The announcement has necessarily been received with some criticism. It is urged in some quarters that the rates are higher than those foreshadowed when the new service was decided upon. Moreover, the term "competition," when prices are the same and the field of service identical, is not very intelligible to the man in the street. Thus, dissatisfaction finds expression in the idea that the intervention of the Post Office has not produced that amelioration in the telephone subscriber's lot which was fondly looked for. It is necessary to review the situation in order to realise just what it is that the Post Office has effected. When "competition" was determined upon, London (unlike the more favoured provincial municipalities) had no provision for intercommunication between the "rival" services. The nominal rate for business premises in London has been £20 per annum, but on a five years' agreement this has been reduced to £17. For a private house £12 has been charged. Thus £12 per annum is the lowest sum for which telephone service could be obtained. This compares with £5 for the future, although the service is not comparable, since for the £12 unlimited calls on a direct line were permitted, whilst the £5 covers only one call per day on a ten-party line. In the Post Office scheme the private house unlimited service finds no place. The assumption would seem to be that, whether residence or business, the telephone used more than four and a half times per day is worth paying more than £12 for. It is in this way that the small user has been catered for in the message rate system. The chances of any such cheap service without Post Office intervention may be gathered from the statement on the subject in a recent report to the shareholders of the National Company.

Instead of calling upon the unlimited user to enter into an agreement for five years at £17, the Post Office will connect up at that rate for one year only. Without further working experience, and having regard to the large growth which may be expected, it probably would be unwise to make a lower rate for unlimited communication over the London area. The avowed object of expected competition was to improve and cheapen the service. We are deprived of the competition in price, but the competition in quality is still available, though the opportunity of judging of such quality must be limited to connections on the individual services. We shall watch with interest the inter-communication of calls between the exchanges of different organisations. The right of inter-communication between the subscribers of a new exchange and the subscribers of an existing exchange is of considerable value to the new authority. Until the terms of agreement are published, we cannot judge whether the price paid for the privilege is high or low. But so far as the public are concerned, it should be clearly understood that a comparison between the existing arrangement and a real competition without intercommunication, would not be complete without assuming that a large proportion of the subscribers would need to pay two subscriptions. We cannot, of course, regard the existing arrangement as more than another stepping stone towards consolidation under one authority. With its admirable system of mains and able engineering organisation, the Post Office system ought to make rapid and steady progress, but it would be idle to deny that its prospects would be improved had the new arrangement caught the public sympathy.

The retirement of Mr. Forbes from the chairmanship of the National Company, and his being succeeded by Sir Henry Fowler, will occasion no surprise. Public comments suggest that Mr. Forbes has completed his *magnum opus*, and that the occasion is a fitting one to choose. Mr. Forbes is full of years; he has steered his barque through troublous seas; his cheery optimism under apparently adverse conditions has been as a tonic to sufferers from depression; he has earned his leisure. It may be matter for regret that he is chiefly recognised for his "astuteness." No one outside an organisation can be in a position to know the ruling principles, but some there may be who might think that a recognition of the fact that telephone service is a matter of scientific engineering, might sometimes have avoided the necessity for the exercise of that "diplomatic engineering," in which Mr. Forbes is so generally recognised as a past-master.

The Berlin Experiments with High-speed Electric Railways.

A CONSIDERABLE amount of interest has been excited by the experiments recently carried out on the military railway near Berlin. Exaggerated accounts of the speeds attained have been published in the daily papers. The following is the history of the experiments up to date, as communicated to the *Elektrotechnische Zeitschrift* by the Association itself. The experiments on the Royal Military Railway were begun early in September; the two express cars were first run on the line by an ordinary locomotive to get them into good working order and detect any defects in the details of their construction. After these preliminary trials, experiments with electric traction were commenced. A start was made with a speed of 60 km. per hour, and this was gradually increased to 100, 120, and 140 km., the highest speed yet attained being 160 km. (99·4 miles) per hour, with a pressure in the supply wires of more than 10,000 volts. The highest speed hitherto attained on European railways is 130 km. (80 miles) an hour, and on American railways 140 km. (87 miles) an hour. The experiments have been on the whole successful, and have afforded opportunity to make important observations on the speed of starting and of stopping with brakes, on the visibility of signals, on the power consumed, and on the resistance of the air. The conductors, the arrangements for taking off the current, and the electric machinery, as well as the cars themselves, have stood the tests so well, that there can be no doubt as far as the rolling stock is concerned, that much higher speeds are possible. The permanent way has proved the weak point, and this is to be strengthened before any further experiments are carried out.

The Signalling of Electric Railways.

THE subject of signalling on electrically-operated street railways in America is apparently becoming of considerable importance on account of the vast development of such systems of travel, the volume and irregularity of the traffic, the distances run, the use of single track with spaced passing places, and the speed at which the cars are run. The difficulty of adhering strictly to a time table under all the vary-

ing circumstances which may and do arise is very great, and American street railway engineers are looking to systematic signalling as a means to increase the efficiency and safety of their lines. A paper read by Mr. W. Pestell at the Annual Convention of the American Street Railway Association in New York on October 9th—11th, which is reprinted by *Electricity* of New York in its issue of the 16th inst. summarises the situation in a luminous manner. The modified form of a despatcher system in use with the aid of the telephone seems to be a failure when the despatcher has to rely upon the car operators to take instructions direct. Naturally, such irregularities of units as it is the despatcher's business to correct, as far as possible, as regards the general body of the traffic, may result in the persons to whom communications are to be made being elsewhere than at the scheduled point. Mr. Pestell's paper bristles with important points in the direction of such traffic, and is worthy of the most careful study by those engaged in similar work in this country. Whilst such systems of transit have been developed to only a comparatively small extent in this country, and signalling, where it is in use, is of the most rudimentary character, yet the careful observer cannot fail to note points on our systems where serious disasters may easily occur from want of guidance, and the absence of the means of regulation enforced in the case of steam railways. By common consent the British subject is the most valuable asset possessed by these islands, and if his safety necessitates the enforcement of rigorous rules when he or she travels on a steam railway, there seems to be no reason why such protection should not be afforded on electric railways. In one case of electric tramway signalling in this country, at a junction, two small semaphore signals are used for, say, the up line—one for the main road and one for the branch. Cars coming on to the main line from the branch foul both the up and down lines, yet it is no infrequent sight to see three cars running to the fouling point at their usual speeds, and the conductors relying upon their brakes to stop in the normal distance. It is sincerely to be hoped that tramway managers will not wait to learn wisdom from disaster. The experience obtained on steam railways is available for their guidance, and it should not be too hurriedly concluded that the conditions obtaining are altogether different.

Mr. Pestell quotes the resolution adopted by the Massachusetts Street Railway Association on the subject of signalling, which may be summarised as follows :—(1) That a telephone system in conjunction with a proper block system is necessary for a safely and satisfactorily operated suburban single track road. (2) That recommendations for the needs of general city traffic cannot be given, as local conditions largely determine what is required; but (3) That the telephone should be owned and operated by the railway company, and a selective system of signals for calling outside telephone stations should be adopted; and (4) That the block signal system should be entirely automatic, and should not depend upon incandescent lamps as visual signals, nor should such lamps be necessary for the continuity of circuits. That signals should be normally at danger, and that they should remain so as long as cars are in the section, and that they should set as far as danger end at first, and be locked at danger before it is possible to operate cautionary signal at near end; that all parts of the apparatus should be in good working order before it is possible to set the signal to safety, and that the apparatus should be capable of operation satisfactorily with pressures of from 200 to 600 volts and should not be liable to burn out under ordinary conditions of contact with live parts of the trolley system. These requirements are sufficiently stringent, and represent, maybe, an ideal system rather than one immediately available. They also show the tendency to automatic working so observable in the signalling on American steam railways at the present time. Manually operated apparatus seems to be at a discount since, in this paper, the author states, in referring to a manually operated switch, that "the men cannot be relied upon for its proper operation."

BILLS AND PROVISIONAL ORDERS—SESSION 1902.

(Second Notice.)

The promotions for next session indicate in a marked manner the change which is coming over the electrical industry. The days of isolated generating stations are numbered, and arrangements for the supply of wide areas under one comprehensive system are indicated in the numerous applications to Parliament for the necessary powers, and the marked diminution in notices for the grant of provisional orders from the Board of Trade for single town installations.

This change in the character of the business is no doubt answerable for the small number of applications for provisional orders—especially by companies—and the important notices for power schemes, including those of several local authorities.

There are three notices of transfers of powers, respectively from a local authority to a company, from a company to a local authority, and from one company to another.

The total number of provisional orders advertised at present is 54, of which 15 are for companies, and 39 by local authorities.

The most interesting of the Bill promotions is that of the London County Council, who make a bold attempt to convert all the electric supply business of the County of London into municipal undertakings, by private arrangements or compulsory purchase.

The object of this comprehensive measure is thus described :—

"Purchase of electric lighting undertakings in or supplying within the County of London combination between the Councils of the Cities of London and Westminster and the Councils of the Metropolitan boroughs; purchase of undertakings by agreement; purchase by the London County Council; management and administration of undertakings purchased; appointment of joint committees; adjustment of boundaries; rights and liabilities as between authorised undertakers; financial provisions; raising of money by creation of stock and borrowing."

There is to be a provision authorising the Council to supply electrical energy in bulk to any local authority.

The capital required is to be raised by the creation and issue of consolidated stock to such an amount as may be necessary, and probably the creators of this great scheme look forward to "Electric Consols" as becoming a gilt-edged security.

There is no provision as to the mode in which the accounts of this great municipal combine are to be made out and audited, but in the event of losses in the trading and from antiquation and depreciation of plant, the local authorities are "to charge any deficiency in such revenue on the County rate or the local rates respectively, or as the Bill may define."

The companies interested in this magnificent scheme are the following :—

	Capital expended.
Brompton	£207,701
Charing Cross	609,830
Chelsea	425,545
City of London	1,728,974
County of London	892,677
Kensington	312,449
Lambeth	255,497
Metropolitan...	1,417,805
Notting Hill	164,990
St. James's and Pall Mall	390,231
Westminster	753,007
Woolwich	47,817
London Electric (1899)	789,256
Crystal Palace District	*89,558
	£8,085,337

* Part of this expenditure was incurred in Beckenham—outside the County of London.

What advantage the London ratepayers are to derive from this wholesale suppression of private enterprise and the creation of a vast municipal monopoly, undertaken by a joint committee of amateurs, it would be difficult to imagine.

The compulsory purchase will add considerably to the cost of the undertakings, and private agreements are not very likely, except with the few unprofitable businesses.

The County Council have another little Bill for General Powers, in which they ask for power to the local authorities to expend money upon wiring and fitting premises of consumers or "prospective consumers," and to borrow money for the purpose. This extension of municipal trading will enable them to destroy the business of the legitimate wiring and fitting firms by establishing departments to supply without profit.

With a water Bill on their hands and so many other irons in the fire (while asking Parliament to extend the time for completing many undertakings), it is astonishing that the Council should launch such an enterprise without the slightest indication on the part of the ratepayers of the County of London that they favour any such speculation.

The new Power Bills announced, include proposed undertakings by both municipalities and private companies. The Birkenhead Corporation want to supply electricity for any purpose within or without the borough, and also to prescribe the form and nature of meters, and to manufacture them. This latter provision will relieve the Board of Trade of their duty to certify meters, and will introduce another element of competition with the private trader.

The Abertillery Urban District Council ask for powers to supply in bulk outside their district, and to go into the fittings business.

The South Shields Corporation want to supply electricity in bulk, but only ask to do so within a mile of the borough.

The Dartford Urban District Council also wish to supply in bulk within any adjoining or neighbouring district.

The Bristol Corporation desire to supply "for all purposes" in parts of Gloucester and Somerset.

The York Corporation yearn to get outside the city boundary and supply in bulk to their neighbours.

The Birmingham Corporation ask to supply outside their city in bulk, and also to take transfers of power and supply other districts.

The companies seeking powers to supply large areas include the Newcastle-upon-Tyne Electric Supply Company, who want authority to supply energy in bulk or otherwise beyond their area of supply, and specify certain districts.

A new company is projected for supply within the county of Kent and for the transfer to them of the Chatham, Rochester and District Electric Lighting Company, Limited, and other undertakings.

Another company is be incorporated for the supply and distribution within parts of the unions of Stratford-on-Avon, Rugby, Warwick, &c., and parts of Leicester.

The Derbyshire and Nottinghamshire Electric Power Company seek an extension of powers by the "removal of restrictions," to enable them to supply and distribute.

A new company is proposed to be incorporated for supply and distribution of electric power in the following unions in Northumberland, viz., the Castle Ward, Tynemouth, Morpeth and Alnwick.

The North Metropolitan Electric Supply Company are applying for an extension of their powers so as to include Willesden in their area, and to supply and distribute energy within the districts of Tottenham, Enfield, Edmonton, Wood Green and Southgate.

This is a goodly fleet to put to sea on the Parliamentary waters, and he would be a bold prophet who could predict how many will reach harbour, with or without damage.

WIRELESS TELEGRAPHY IN ITALY.

[COMMUNICATED.]

It is well known that the Government of Italy, the birthplace of the inventor Marconi, was one of the first to organise official experiments in wireless telegraphy. In fact, it was in July, 1894, that the first experiments in Italy took place, in the first instance, at Rome, between two different floors of the offices of the Naval Administration, and afterwards at Spezzia, both trials being under the direction of Marconi himself, who had been expressly invited to come to Italy by the authorities of his country and at the initiative of several of the superior officers of the army and the navy, who even then understood the importance of wireless electric telegraphy and the brilliant future in store for it.

Successful results were obtained from these tests; battleships of the Italian navy communicated with the coast of the peninsula at a maximum distance of 16 km., with antennæ of 22 and 34 metres.

Since then experiments in wireless telegraphy have continued uninterruptedly in Italy at the instance of the Ministers of the War Office, and especially of the Naval Administration, to whom Marconi at the time of his experiments at Spezzia had given permission to use his apparatus, and also all the improvements and additions which he might subsequently design for his instruments, which at that time were necessarily primitive. The experiments in question were at first directed by M. Pasqualine, electrician-in-chief to the Navy, and by M. Civita, engineer, and now editor of *L'Elettricita*, of Milan. During the first set of experiments, which cost the Italian Government about 100,000 fr., very interesting results were obtained; several battleships were fitted with the apparatus, many stations were established on the Italian coast, and communication was effected at a maximum distance of about 100 km. between a vessel out at sea and a fixed station on the coast.

When Messrs. Pasqualini and Civita retired from the Italian Navy, the wireless telegraphy service was entrusted to the officers themselves, amongst others to Commander Pouchain, now chief of a division in the Navy, and to Lieutenant Solari, who recently proposed to the Administration to connect Pekin with the Bay of St. Mun by wireless telegraphy with the aid of several relay stations, or Guarini repeaters.

Then followed some unsuccessful experiments, for instance, between Messina and Reggio, at a distance of a few kilometres; but we also heard of signals reaching English battleships off Malta, having been sent out by Italian battleships off Sicily, the distance between them being about 200 km.

It is certain that the Italian Navy has achieved very great progress in the use of wireless telegraphy. In fact, not long ago, the Italian Navy succeeded in connecting Sardinia by wireless telegraphy with the mainland, the communication being between Monte Argentan and the Maddalena, thus traversing a distance of 200 km. over the sea.

This brilliant result far surpasses that attained in France, some few months ago, by Marconi himself, with apparatus manufactured by the Wireless Company, between Calvi (Corsica) and Antibes (Provence).

This splendid success is due to the officers of the Italian navy and to the special staff of this important department, who, for four consecutive years, with admirable perseverance and intelligence, have been studying the question of wireless telegraphy, constructing in the arsenals of the kingdom greatly improved apparatus, and carrying out many experiments between the provisional stations established on the higher ground.

The above-mentioned experiments, which have been of great importance to Italy, from both a military and a commercial point of view, were effected without foreign assistance, with very limited funds, granted for the purpose in the budgets; whereas in England, in France, and especially in Germany, scientific men, learned societies, civil and military technical experts, have spent a great deal of money to obtain a result similar to that obtained by the officers of the Italian navy. In a little while a fixed and regular communication between Rome and Sardinia, and the abolition of the submarine cable now in use, will be an accomplished fact. It is proposed to connect Rome with the coast by means of wireless telegraphy, using an automatic relay, but it is almost certain that for the present, at any rate, communication between the capital and the coast will be effected by the ordinary telegraphy.

Before attempting communication with the aid of a relay station, the naval department has decided first to try direct communication. The Continental station will be on Monte Mario, in the environs of Rome, the Sardinian station being established on the island of Caprera (on a hill), where rest the remains of Guiseppe Garibaldi.

Besides the wireless telegraph apparatus working on various Italian battleships, there are at present five stations established in the mountain region in very good working order. It is said that in the course of their numerous experiments in wireless telegraphy the Italian officers have made some very interesting discoveries and observations, some of which, particularly some in connection with the antenna and the part it plays in wireless telegraphy, are of a nature to clear up, completely and definitively, things up to the present imperfectly explained, if not completely enveloped in mystery.

It is deeply to be regretted that the Italian Government does not follow the example of other countries, *e.g.*, England, Germany and America, in publishing *in extenso* the reports of their officers and others appointed to make official experiments.

In the interests of science and for the advantage of all those—and they are numerous—who, in various countries, are working at wireless telegraphy, we hope that the Italian authorities will reconsider their decision and publish the complete results of the experiments in wireless telegraphy conducted by their subordinates, and we urge this the more earnestly in view of the fact that in our opinion it is not a question of safe-guarding military secrets and protecting commercial interests.

CURRENT SPECIFICATIONS.

LXXXII.—ORDNANCE SURVEY OFFICE, SOUTHAMPTON.

Summary.

Extent of Contract.—Supply and erection of 18 motors, together with the supply of specified switchboards and wiring.

System of Supply.—Current to be obtained from Corporation. Direct current supply at consumers' terminals at 520 volts, the negative pole being earthed.

Type of Motors.—Four to be entirely enclosed, 14 of semi-enclosed type.

Size of Motors.—Varying sizes up to 6 B.H.P.

Purposes for which Motors are Required.—Principally for driving printing machinery, to the various specified machines of which the motors are to be connected through spur gearing.

Motor-Generators.—Two to be supplied; one for supplying current to arc lamps to be used for photographic purposes, to be wound on the motor side for 520 volts, and on the dynamo side to give 140 amperes at 110 volts at a speed not exceeding 1,200 revolutions per minute. The other to consist of motor wound for 520 volts, driving two dynamos, one to give 300 amperes at 10 volts and the other 60 amperes at 5 volts at speed not exceeding 1,200 revolutions.

Specified Temperature Rise.—After six hour's run at full load not to exceed 60° F. above surrounding air for semi-enclosed, or 80° F. above surrounding air for completely enclosed motors.

Specified Insulation Test.—An alternating pressure of 1,000 volts to be applied immediately after a six hour's run at normal full load.

Type of Gearing.—Raw hide pinions on motor spindle working into machine-cut cast-iron spur wheels on driven machine.

Switchboards.—To be supplied as specified.

Specified Date of Completion.—To be stated by tenderer, and arrangements to be made with consulting engineers when contract is arranged as to the dates on which the various sections will be completed.

Penalty for Late Completion.—1 per cent. of contract price per week.

Terms of Payment.—On monthly certificates up to 60 per cent. of value of work done and plant delivered on site, a further 20 per cent. when engineer certifies plant can be put into use, a further 10 per cent. on receipt of engineer's certificate of satisfactory completion of contract, and 10 per cent. six months later.

Period of Maintenance.—Six months from date of completion.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be Paid to Workmen.—None.

Arbitration Proposals.—Acceptable; see comments.

Consulting Engineers.—Messrs. Preece & Cardew.

Date for Receipt of Tenders.—December 14th, 1901.

This specification, prepared by the well-known firm of Messrs. Preece & Cardew, provides for the supply and erection ready for working at the Royal Ordnance Survey Office, Southampton, of a number of electric motors. These motors will be supplied with current from the Southampton Corporation public supply mains at 520 volts, and will be largely used for driving printing machinery. The contract includes the fitting of a number of the motors to the various printing machines specified, through spur gearing, and suitable provision is to be made for obtaining different specified speeds. It is suggested that all tenderers examine the character of the work to be done before submitting an offer.

Time is an important element in the carrying out of the work, and special care is to be taken that the various machines are out of use for as short a time as possible, the work being carried out in the various rooms as arranged between the engineers and the contractor.

The general conditions are, on the whole, acceptable; it should be noted that so far as the carrying out of the work is concerned, the decision of the engineers, in case of dispute, is to be final. If, however, there is any difference of opinion regarding the sums to be paid to the contractor, it is open to the parties to refer the matter to an arbitrator, to be appointed by the President of the Institution of Civil Engineers. We do not like this division of matters of difference into two classes, one class subject to arbitration, and one not. As a matter of principle, it should be possible to refer all subjects to independent arbitration, but in a case like the present, where the engineers have a high reputation, we are aware that many firms take the responsibility, and are willing to accept a partial arbitration clause, such as the one in question.

The terms of payment differ from those usual in electrical contracts, but inasmuch as not more than 10 per cent. is retained for six months from date of completion, they may be accepted without demur.

INSTITUTION OF ELECTRICAL ENGINEERS (MANCHESTER SECTION).

Inaugural Address of the Chairman, Mr. C. H. Wordingham,

It is no formal or conventional thanks that I render to you this evening for the honour which you have done me in electing me chairman of this highly important local section of the Institution, for I appreciate most keenly this mark of your esteem and confidence. I can only say that during my term of office I shall look upon it as a great privilege to do everything that lies in my power to promote the success of the section.

It is a recollection of the early days of the Northern Society which makes me feel so confident of the success of our own local section, for we have the same men among us that we had then, and we have in Mr. Cowan an honorary secretary whose competence for the work and energy in carrying it out could not be surpassed, while the inducements to members now are much stronger than in the days of the Northern Society to prepare papers and take part in our discussions. Our proceedings form part of those of the Institution, and papers, if of sufficient merit, are printed in the *Transactions*, being equally with those read in London eligible for premiums.

I trust, therefore, that members who are in a position to do so will come forward with papers, and that all will make a point of attending our meetings and taking part in our discussions. Especially do we want the young men, those who so far are unknown, for nothing is so painful as to hear only the same voices meeting after meeting, and not the least so to the speakers themselves who often take part in the discussion solely because they do not like to see it languish altogether.

One of the great difficulties we have to contend with is the provision of a suitable place in which to meet. Through the courtesy and generosity of the authorities of Owens College, this excellent theatre has been placed at our disposal, and I am quite sure that we all heartily appreciate their action.

It is quite hopeless for the Section, unaided, to provide any accommodation of its own, for we have but a limited grant for current expenses from the Institution, and we could hardly expect the Council in London to make any effort to provide a meeting place for a local section, when the Institution itself is entirely dependent upon the hospitality of older and richer corporations for its own meetings.

There does, however, seem to me to be a way in which the difficulty might be solved if only the various engineering and scientific societies in Manchester would pull together. Manchester has long been prominent as an engineering centre, and it bids fair to eclipse all others as a seat of electrical enterprise. The local engineering and scientific societies are at least as important as any out of the metropolis; they are numerous, there being upwards of 30 local sections or branches of London institutions, and some of them are extremely well provided with funds. At present all these societies meet in different places, many of them in hotels, and the aggregate rent paid in the course of a year must be very considerable. Surely all these Institutions, which have this in common, that they are seeking to promote the interests of science in either its abstract or its applied form, might combine together, and jointly provide or rent premises which should afford a suitable and convenient place of meeting, and, at the same time, accommodation for their respective libraries.

Manchester, as a city, prides itself upon being in the van of municipal progress, and its citizens have provided funds for an Institute of Technology which has been planned to be as near perfection as money and thought can make it. With the opening of this Institute, there is being inaugurated a new area in the technical education provided in the district, and the standing to be taken by this new Institute depends very much upon the line of action taken in the

early stages. Already there are signs that the authorities desire it to be something more than a mere technical school, and it would seem that an effort is being made to secure this by making the status of the staff as high and dignified as possible. It appears to me that the opportunity exists at the present time of immensely adding to the dignity, and of greatly improving the position of this Institute by the authorities stepping in and bringing together under its wing the various societies and affording them that material assistance which many of them lack, while receiving in exchange the support and weight of all that is best in the scientific and engineering circle of the district. I raised this question some six months ago at a meeting of the Society of Chemical Industry in Manchester, and judging from one or two paragraphs that have lately appeared in the newspapers, there seems to be some prospect of such a scheme being considered, and I sincerely trust that it will receive the hearty co-operation of all concerned. It is my intention to bring this matter before the Committee of this section at the earliest opportunity, and I hope that by our united efforts some effect may be produced, and that we may be able to report to you that our negotiations have been successful.

There is one other subject of local interest to which I desire to refer, namely, the question of students of the Institution. In the days of the Northern Society this class was practically non-existent, but now that we are a branch of the Institution, there are naturally a number of student members entitled to attend our meetings, and this class has been substantially augmented by the joining *en bloc* of a society promoted under the auspices of Mr. W. H. H. Gee in connection with the pupils at the Technical School. There must be a large number of young fellows who are receiving their education in the important engineering works of the district, and considerable numbers cannot fail to be attracted by the new Institute of Technology, so that we may look forward to a substantial growth in numbers of this class of member. All of us who have been students of the Institutions in London, particularly of the Institution of Civil Engineers, must have felt what an immense benefit was derived by us from attending the students' meetings organised by these Institutions. It is, in my opinion, difficult to over-estimate the educational value of preparing papers to be read at such meetings, and of the training in debate afforded by taking part in the discussions. I look forward to the Committee being able to organise, even with the present members, meetings of the kind, and I hope that it may be found possible to make arrangements for visits to works of interest during the session.

We are now passing through an extremely critical period in the development of electrical engineering in this country, and much depends on the attitude assumed by every individual member of the profession.

Are we prepared for this development? Are we fit to step forward and say the demand exists in our country, we are prepared to supply it?

If one may judge by common report, we are not. The undoubted fact is pointed to that contracts for large works are awarded to American and Continental firms, and the inference is drawn that English makers are unable to undertake them, and are either behind the times or incompetent.

This charge is a serious one, and, if well founded, means not only that British electrical engineers are a failure, but that the decadence of the engineering industry of this country has set in, for what branch of engineering has not now been made electrical in some measure?

Let us examine a little more closely the common report. Whence does it emanate? Largely, no doubt, from the daily press. Unsupported, the press would probably not do much real damage, but unfortunately electrical engineers themselves seem to be but too prone to lend colour to the story of their own incompetence; while the fact that their foreign competitors are successful in securing contracts is, to the lay mind, convincing proof of the latter's superior fitness to carry them out.

When an English engineer goes abroad, he seems to feel it incumbent upon him to express amazement at what he sees, to praise every detail of the plant or works he inspects, if it differ from what he has been used to, without stopping to inquire whether it be better or worse.

When our Englishman comes home he makes pessimistic speeches, eagerly reported by the daily press, as to the marvellous advance made by foreign nations, belittling his own achievements and those of his colleagues, and for months he fills his technical papers with absolutely gratuitous fully illustrated advertisements of his rival's works.

But the stay-at-home islander is not to be outdone by his travelled brother: he has specifications to draw and plant to purchase. What is the blackest crime in his eyes? A preference for native-made plant. The mere suggestion that he has such a preference at once raises the blush of shame. No, he is no "spread-eagle" or "Jingo"; he does not think the nation whose name in foreign markets is a guarantee of genuineness and good quality is any better than others, and he will gladly waive his most cherished conditions in order to give an extra chance to the foreigner, and thereby show that he is a "citizen of the world," forgetting that

> "That man's the best cosmopolite
> That loves his native country best."

If, then, the engineers themselves eagerly praise their rivals, can we blame the man in the street if he assumes the inferiority of his own countrymen to be a fact, for he could never guess that their self-depreciation arises from politeness and modesty. But, you will say, why do the contracts go abroad? If the work can be done here, why is it not? That is a question which cannot be answered in a word because the reasons are manifold and varied.

In many cases, no doubt, the work has been done for less money, and we will assume that it has been done as well as if the contract had been in English hands, though this assumption is, in many cases, far from the truth. Are we justified in drawing the deduction that because the machinery, or whatever it may be, is sold for less, therefore the foreign manufacturer has produced it at less cost than we, thereby showing that his practice is in advance of ours. By no means. It must be borne in mind that the English market is a comparatively new one to foreign makers of machinery, and the merest tyro in commerce knows that in order to push his wares he must advertise. Advertisement necessarily costs money, and the payment may advantageously take the form of a discount on the goods first sold. For not only are they thereby brought under the notice of possible future buyers by being got into the country, but the trade is actually begun by the very fact of lowering the price. It is an old device, but it never fails. Men always have sought for bargains, and always will. The Nemesis comes later.

Again, over-production and industrial depression in the producing country has, undoubtedly, had much to do with the low prices of some of the plant sent into the English market, manufacturers being ready to sell at almost any price rather than discharge their hands and admit the rotten condition of their trade.

Low price is not, however, the only consideration that has determined the award of contracts for electrical machinery out of England. Promises of early delivery have been almost, if not quite, as potent. The purchasers will procrastinate for months or years, allowing every trivial matter to delay them, but once they determine to go forward their lethargy is exchanged for panic and unreasoning haste. Here, again, over-production enables the foreigner to secure many of the contracts, which, in this case, are often awarded to him regardless of price because he can promise early delivery. The purchaser never considers that other contracts which must be executed first, cannot, by their very nature, be carried out in so brief a period, and he finds subsequently, to his cost, that the plant, for which he has paid more than he would have had to pay to an English firm who required a reasonable time for delivery, is on his hands deteriorating and costing him heavy sums for demurrage. Meanwhile there has been the usual cry of the vastly superior resources of the foreigner, and the mischief has been done to the English manufacturer—mischief which is unremedied, because the public never hears the end of the tale.

I ought, perhaps, to touch upon the question of the relative quality of the British and foreign-made machinery. Let us at once grant that much of the latter is excellent, while, at the same time, it must, in common fairness, be admitted that much is unconscionable rubbish. Do we, who are in daily contact with British machinery, honestly believe that our manufacturers are in any one respect incapable of making as good machinery as any imported into this country? Do we not know that from British workshops is turned out machinery that it is impossible to better whether in design, in workmanship, in finish, or in durability? And do we not know that our alleged inferiority is a delusion.

In the past English engineers have been in the fore front. An Englishman, nay, a Manchester man, John Hopkinson, taught the whole world how to build dynamos. The earliest attempts at heavy electric traction were made in this country. An Englishman, Ferranti, first conceived and executed the idea of commercially working at high pressure, and devised the means whereby it might be done with perfect safety. An Englishman, Hughes, gave to the world the invention which made long-distance telephony possible. By the invention of an Englishman, Swan, domestic electric lighting became an accomplished fact, while English engineers have carried out almost the whole of the submarine cable work of the world. With this record behind us, is it likely that we shall cease to be in the van. Most assuredly not, unless our fellow-countrymen take the heart out of us by ceasing to believe in our capacity and by belittling our achievements.

I do not wish my remarks to be misunderstood. I do not for one moment seek to imply that good work is not turned out from foreign workshops, or that we as a nation have any monopoly of engineering skill. On the contrary, I yield to none in my admiration of the splendid achievements of our American brethren, and of other nations more distant in blood but nearer home who are following in their steps. I have merely endeavoured to show that the position at the present time really is that English makers are fully equal to their competitors, but they are being driven out of their home market, not because their rivals can produce better, more cheaply, or more quickly than they, but because these competitors are willing for a time to undersell them, while over-production enables them at present to forestal them.

Having extolled our virtues as electrical engineers, it is only right that I should turn to our faults. It seems to me that two stand out prominently. One is a tendency to rush to extremes, the other is a want of foresight.

The former of these faults showed itself in the early stages of the industry, one of its most noteworthy manifestations being the once notorious conflict between the advocates of high pressure alternating and low pressure continuous current; feeling actually ran high over such a purely technical matter, but now controversies involving wide issues are conducted with positive acrimony, and the views are as extreme as those held by opposed political parties.

One example will at once occur to every one, namely, the question of municipal *v.* private enterprise. In its essence, this is a purely political consideration, and with politics, and their attendant prejudices and intrigues, it is well for engineers to have nothing to do so far as their work is concerned. To some of us it may seem that Tennyson's words have a wider application than that implied by their context that

> "Our little systems have their day,
> They have their day and cease to be."

applies to all forms of government, that all are "broken lights" of true and equitable rule, and that probity and uprightness in individuals are far "more than they." In other words, that people may be justly and well governed by the unbridled autocrat, and by the latest socialistic community, provided that in each case the individuals bearing authority are single-minded and seek the good of the governed.

Be this as it may, it cannot be denied by those who have had experience of undertakings, managed both by a board of directors and by municipalities, that both can attain excellent results, and that both can produce abject failures. It is no more fair to brand every member of a Municipal Council as a Bumble, a fool, a seeker after his own ends, and blinded by prejudice, obstructiveness, and ignorance, as it is to look upon every member of a board of directors as an unscrupulous company promoter, a selfish grabber of dividends, and an enemy to the public. Both views are absolutely unjust, and able, upright, conscientious and straightforward men will be found directing the operations of both classes of undertaking.

No fair-minded man can deny that some local authorities have adopted tactics of the most unfair obstruction, and have sought to prevent others carrying out work which they themselves have refused to do, but, on the other hand, it must equally be admitted that some companies have been worked solely in the interests of the shareholders without any regard to the welfare of the public, while others, in order to gratify the greed of the promoters, have been over-loaded with capital to such an extent as to render it impossible for them to satisfactorily serve the public.

Having glanced at the extreme views so constantly reiterated, let us endeavour for a moment to look at the question impartially.

Judged by results, as shown by the returns in the excellent manual compiled by Mr. Garcke, who certainly cannot be accused of unduly favouring municipal enterprise, the municipalities have done better than the companies, for they have made a profit on their capital, only $\frac{1}{4}$ per cent. less than the companies, while the average price they have charged is over 22 per cent. less. The subject must, however, be considered from other points of view, for the side issues are of far-reaching importance.

(To be continued.)

LEGAL.

FERRANTI *v.* THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED.

(*Continued from page* 831.)

MR. S. Z. DE FERRANTI, M.I.C.E., M.I.E.E., examined by Mr. COLEFAX, said he was thoroughly conversant with all branches of central station equipment, and with the history of the development of electrical meters. It was one of the first things he had worked at. There were several meters, theoretically, between Edison's electrolytic meter and the witness's own, but they could not be used practically. A few hundreds of his 1883 meters were used. The business of a central station supply in those days was exceedingly limited, and very few meters were required. They had a great aversion from starting with a small load, by reason of the static friction in the meter. The invention of 1887 was designed to overcome that difficulty. In the earlier invention a solid magnet was used, and it retained considerable residual magnetism, which was what was commercially wanted, and started the meter with a small number of lamps. A solid magnet would be out of the question in a meter for an alternating current, and he had therefore to use a laminated magnet. This did not retain residual magnetism, and it was this difficulty of static friction which had to be overcome. It had always been his view that an energy meter was a motor-meter. If the current to be measured was taken away, it was no longer a meter, and did not go. The function of the subsidiary coil was absolutely the same, whether in series or shunt.

Supposing the pressure to vary considerably, would the defendants' meter act as a meter at all?—When fitted with the additional shunt starting coil, it would be wrong as an energy meter. If you leave that out, it is theoretically right. Continuing, witness said it would not be a correct meter, because the current through the additional starting coil went up, say, as the voltage went up, and that meant that the meter, if the pressure was raised, would run without any lamps being turned on. That was a very serious thing in meters, because people objected to it distinctly. That was a thing that occurred in practice occasionally. It was a correct meter when used within close limits, that was to say, under the same conditions as a quantity meter. When the current went down in pressure, the compensation was insufficient, for the registration was lower than it should be at low loads. Whichever way the voltage varied, up or down, an inaccuracy came in.

Cross-examined by Mr. MOULTON, WITNESS said residual magnetism, as against permanent magnetism, was generally used to mean that slight amount of magnetism left in a piece of iron when it was not intended to register any.

You quite agree with me that its retention makes no difference here. Permanent magnets have been known for many years as equivalents; that is to say, if you had a permanent magnet, you could substitute an electro-magnet for it?—Also a coil with a current passing through it. All those are the same.

The 1887 patent simply consisted of substituting for the permanent or residual magnetism a little electro-magnet of equal strength? It is not quite as simple as that. You must have a coil which is in shunt to the main.

But that is your electro-magnet?—Yes; but to say an electro-magnet alone does not convey the meaning. You must laminate your core as well.

The 1887 was a current meter, meant to work at a constant pressure?—Yes.

Therefore that constant pressure would give you a constant electro-magnet?—It would give you a constant shunt-starting current.

A constant electro-magnet?—As produced by the shunt coil, not as produced by the main coil.

That is exactly what I say. You are going to substitute for your permanent magnet of 1883 an electro-magnet. If you put a coil between mains, that gives it to you?—Certainly.

A permanent magnet?—Certainly, only it was an alternating permanent magnet, which does not exist.

There is nothing in your patent to confine it to alternating currents?—No.

In other words, suppose our meter was taken as a meter for direct currents, it would be equally an infringement?—According to my view it would.

You will admit that your specification describes only current meters?—The particular case illustrated and described is current meters, but that is not all it says.

The claim talks about a part of the current to be measured, so that it looks upon it as if the current was what was wanted to be measured?—The current in this specification does not mean quantity only. Current is thoroughly well known as meaning a supply of energy when you talk of a supply of current.

Do you say that a current meter means an energy meter?—A current meter may mean both. A quantity meter is one thing, an energy meter is the other. Those are the correct definitions—the clear ones.

You have known these Thomson-Houston meters for years?—Yes; I have, unfortunately.

When did you first come to the conclusion that they were infringements?—Years ago.

Re-examined by Mr. COLEFAX: The claim in the 1892 patent was somewhat ambiguous. What he meant was a second electro-motor for starting—an additional one for the purpose of measuring. That produced a compensation at the same time. In 1887 there was only one armature and one field. In the other the measuring was done in one part of the apparatus, and the starting and compensating by a separate small piece of the same kind.

Supposing you passed the current which passes through the subsidiary coil through the mercury, you would have a great deal of current in the mercury, namely, the current passed through the subsidiary coil?—Yes.

Supposing that you had your standing field, that is, what we have called the field, produced by the main circuit on the magnet—supposing you had those two interacting, would you necessarily have movement in the meter?—Not until you got sufficient current in the mercury to overcome the initial friction.

WITNESS, continuing, said somewhere about $\frac{1}{50}$th to $\frac{1}{100}$th of an ampere passed through the subsidiary coil. It was negligible as regarded registration. The presence of the armature in the defendants' meter did not in any way affect the function of the subsidiary coil. The reason why this connection, or this flow of current, was used in practice, was to enable the shunt coils to be wound round with rather thicker wire than they would be if they were each one separately across the main. Putting the armature and the shunt coil in series was done for a commercial reason. It enabled cheaper and easier construction. The defendants put an additional resistance in as well, and he (witness) had done the same thing. The action was absolutely the same. The result was the same, but commercially it was cheaper and better.

Mr. C. H. WORDINGHAM, M.I.C.E., M.I.M.E., lately electrical engineer of the Manchester Corporation, examined by Mr. COLEFAX, said he did not know of any practicable means by which a meter could be rendered accurate at low loads, before the date of the plaintiff's patent.

Mr. MOULTON: I put it to you that the 1887 meter did not differ from the 1883 meter so far as direct currents are concerned. The 1887 meter is one with a shunt coil?—Yes; I am not aware that they were largely used with a shunt coil with direct currents. I cannot see the object of it.

It does not matter whether you have a permanent magnet or whether you have a permanent electro-magnet so far as direct currents are concerned?—It depends upon how you energise the electro-magnet entirely whether it matters whether it is a permanent magnet or not.

I say it does not make the slightest difference whether your constant field is made by a permanent magnet or whether it is made by an electro-magnet of permanent strength?—If you provide permanent field independent of the current to be measured, it does not matter from what source you get the permanent field.

In continuous currents it is the same thing as 1883?—I have explained that if you provide a field which is constant, it does not matter whether it comes from a permanent magnet or from an independent circuit.

Therefore, so far as the direct current is concerned, this does not add anything to the 1883?—It is one way of effecting the same object.

I put it to you that very few Ferranti meters with the starting coil are used now?—I do not suppose they are now, but certainly they were in practical use, several hundreds of them. On the circuits of the London Electric Supply Corporation they were exclusively used for a considerable time. Subsequently a number of these Ferranti meters were used by other companies, and are now.

Re-examined: Plaintiff's invention was applied to-day, practically, to all motor-meters.

Mr. Wm. A. Chamen, chief electrical engineer to the Glasgow Corporation, also gave evidence.

Mr. Astbury having summed up the plaintiff's case,

Mr. Bousfield, in opening the defendants' case, hoped his Lordship would not object if Mr. Moulton and he reversed their parts. His learned friend (Mr. Moulton) who was then engaged elsewhere, would sum up the evidence, and he (Mr. Bousfield) would proceed to state the defendants' case to his Lordship. On the question of infringement, his Lordship had got to see on the specification what the patentee claimed to have invented. He would have to try to get to the substance of what his invention was by looking at the specification. Moreover, it was clearly pointed out in a case in the House of Lords that it was not open for an inventor to say that the substance of his invention was something different from what was described in the specification. Having got so far, his Lordship had to see whether the defendants had taken the substance of the plaintiff's specification. As regarded the question of subject matter, he did not think that his learned friends quite appreciated the way in which the defendants put that question, and in which they used the specifications of Brush and Phillips as to prior knowledge of shunts and series in winding in reference to dynamos and motors. The defendants said that if the specification was to be properly construed it was for an invention directed to a particular point, namely, that when you substituted a laminated magnet for an electro-magnet of cast-iron you could get the effect of residual magnetism, which you had in the case of the iron magnet, thus producing no new result. That was all the plaintiff invented, and all he claimed. If his invention was going to be limited to that, it was clear the defendants had not touched it in the slightest degree, because they did not deal with magnets at all, or with residual magnetism at all. In that case, the question of subject matter could have the "go by," and if his Lordship construed the specification in that sense, the defendants would not desire to contest it. But if it was said that the defendants were not to use a shunt coil to any form of motor-meter, that was different. In claiming that, the plaintiff was claiming something which he had not invented. They (defendants) said that the use of a shunt coil for the purpose of increasing or decreasing the intensity of the field was perfectly well known before this date. You might be entitled to take the device of a shunt coil and incorporate it along with your laminated magnets to answer certain purposes, and you might be entitled to prevent other people substituting laminated magnets for other magnets; but if you went beyond that, and were going to say—"I have not thought how I am to apply my shunt coil in an energy meter, and it is true that it effects a different object, and is to be applied in a different way, still, nevertheless, the shunt coil helps to start, and therefore you infringe," the defendants said that such an invention could not be claimed, and it was not good subject matter for a patent. The defendants' case was that a shunt coil for an electro-magnet was one of the elements common to electricians—one of the elements they could use in any particular combination they desired, and they were not to be prevented from using it for an obvious purpose in a new combination because somebody else had used it for a different purpose in another. Dealing with the question of prior knowledge, the learned counsel said that Brush used the shunt coil in a way analogous to the defendants. This was a subsidiary thing in Brush as in the defendants', and was to give him a small current running round the shunt for assistance. Here the shunt coil was added to electro-magnets, not for the purpose of producing the effect of residual magnetism, but for the purpose of doubling or trebling the effect of residual magnetism. It was put on a constant field to make it a stronger magnet when the main current did not make it strong enough. He (counsel) said that was illustrative of what his Lordship had got evidence of, viz, that the putting a shunt coil into the magnet was well known to electricians for purposes analogous to the present case. Dealing with Phillips's specification, the learned counsel said that was the case where there was the use of the shunt coil in combination with a series coil for the purpose of assisting it or subtracting from it. The defendants used that specification as general evidence as to common knowledge of shunts and series winding, and to show that the use of a shunt coil in combination with a series coil for the purpose of adding to or diminishing the field for any particular requirements, was well known to electricians.

His Lordship asked if there was any dispute between the parties that the plaintiff's was the first application of the shunt coil to a motor-meter of any kind?

Mr. Bousfield replied that the application of a shunt coil in that particular way was the first. Continuing, he said it had been suggested here that the invention was in introducing a compensation, which should enable the meter to start. Now, in one sense, that was true, and in another sense it was not; because that was old. In the passage in the specification it read:—"In these meters as heretofore constructed there has been a pole-piece of cast-iron which retained a certain amount of residual magnetism, and this served to assist in causing rotation of the mercury whenever a feeble current was passing, and helped to start the meter." So that his Lordship would see that the plaintiff did not profess in this specification to have invented the idea of having an initial torque to help start it. That was old. All that he was going to do was to have the well-known electrical device of a shunt coil to effect the object previously attained by the residual magnetism. All he had to do was to apply a well-known shunt coil for the purpose of getting for the laminated magnet the effect of residual magnetism which was in the pole-pieces. That was all he invented, and as he, counsel said, on the true construction of the specification all he claimed. Now what had the defendants got? His Lordship knew they had introduced a coil into their meter which was in a shunt circuit, in a way which had a totally different effect upon the law. The defendants had got a shunt acting in conjunction with the main field, and therefore his Lordship could see the defendants had not the same condition at all to deal with as the plaintiff had when he had introduced an additional coil into his meter. That which the plaintiff had invented was not what the defendants had taken at all. What the plaintiff had to apply his mind to was how to fit something into his meter, and he made use of something well known to electricians, viz., a shunt coil to a magnet—the plaintiff fitted it in, and it was a useful thing. Anything of that kind would be of no use to the defendants. They had already got the torque proportional to the number of lamps. The purpose of the additional coil in the defendants' was to give correction and of a totally different character. It had to be thought out quite independently of the plaintiff. The problem the plaintiff had to solve was having a laminated magnet without residual magnetism. In the defendants' there was nothing about the effect of residual magnetism. They had in theirs the force in their field because they had the shunt current in the armature, and the problem the defendants had to solve was the friction. There was nothing analogous to residual magnetism in the defendants' meter, and that was not the particular problem they had to solve. The use which the defendants made of this shunt coil was a use of a different kind to that of the plaintiff in his meter. If you liked to reduce the invention to the form of its being a starting coil, he (counsel) could not but admit that the shunt coil helped to start the defendants', but the question of helping to start was of little importance in the defendants' meter, because they had already got the current going through the armature, which gave a field there which was as ready for two or three lamps as for 50. It was perfectly true that the word current was loosely used sometimes, but when you talked of measuring current you could only speak of it as a measurable quantity, and then nobody could confuse the distincton between current and pressure.

Mr. Jas. Swinburne and Prof. Ewing having given evidence,

Mr. Fletcher Moulton, in summing up the case on behalf of the defendants, said it often happened in scientific cases like the present, they had in the examination in chief and the cross-examination of witnesses to deal with a number of points connected with the alleged infringements and the articles made according to the patent—points of difference as to the improvements of the discovery, as to its novelty, and as to the extent to which such an invention had been sought—all matters that might be relevant and might not be relevant. The result was very frequently a considerable chaos on these points, but he (counsel) would promise to help his Lordship as far as possible to disentangle these matters and put them in logical order bearing on the real issues in this case. He did not think his Lordship would find there was very much that was difficult either to understand or to give its logical value to. He would therefore commence by a consideration of the letters patent, so that its terms could be understood and properly construed. It had often been said that a patentee had to make an invention and then properly to describe it, then properly to claim it. Then the only question was whether the invention was in substance stated. They had got here a specification which showed what the invention was, and which was defined by the claims, and when one took the description and claims together—especially when one considered that, according to English law, you had to publish a provisional specification first showing the nature of your invention before you publish a complete specification—you would have no great difficulty in saying what the invention made was and what was the claim. It was needless to say you could not claim more than you invented. He (Mr. Moulton) would ask his Lordship to say that the interpretation sought to be put upon the claim of the letters patent by plaintiff was far too wide, that it was an afterthought whereby the inventor sought to claim that which he never intended to include in his patent, and which he himself probably never thought of as a useful invention at the time he took out his patent. He would ask his Lordship to turn to the complete specification, for he proposed to direct his attention to it somewhat in detail, because he thought upon that his Lordship would be able to come to a conclusion on the whole case. The provisional specification he need not direct his Lordship's attention to, because it was repeated verbatim in the first two paragraphs of the complete. The first paragraph of the specification read: "My improvements relate to electrical meters of that kind in which the current to be measured is made to pass through a bath of mercury in a magnetic field, so disposed, as to put the mercury into continuous movement whenever a current passes, and in which the movement of the mercury is recorded by causing it to impart a revolving motion to an axis whose revolutions are recorded by a counter, or in which the movement of the mercury is recorded in other convenient way. An electrical meter of this kind is described in the specification of a former patent granted to me, No. 5,926, in the year 1883." The first thing they had there was that in describing the general nature of his invention, the plaintiff said that it related to a particular type of meter—a type that they knew, for the 1883 specification had been before his Lordship. That was the mercury meter. He described his invention as relating to this mercury meter. Now that, beyond all question, was a current meter, which they would call the 1883 meter. "In these meters, as heretofore constructed, there has been a pole-piece of cast-iron." That was to say, the current passed round the magnetic field, and then through the mercury bath, but that pole-piece was made of cast-iron. "In these meters as heretofore constructed, there has been a pole-piece of east-iron, which retained a certain amount of residual magnetism, and this served to assist in causing rotation of the mercury whenever a feeble current was passing, and helped to start the meter." His Lordship had had the explanation of residual magnetism. What it meant was that when the current ceased, there still remained a

feeble magnetism in the iron. It was exactly the same as if the pole-piece was of soft iron, which would not keep the magnetism, and then there was an additional pole-piece, which kept it for the present. He (counsel) thought that the whole of the specification was very accurate in language. His Lordship would notice that the magnet would have no tendency to cause rotation in itself, but would only cause rotation when a current was passing. The plaintiff perfectly realised here that his meter was one of that type in which there was no tendency to move until a current was passing; but when a current was passing, even a feeble one, this would help to move the meter. He then went on: "An electric meter of this kind can be used advantageously for recording the passage of a continuous current, but for an alternating current it would be inadmissible to use heavy blocks of magnetic metal, the polarity of which would be constantly reversing. I, therefore, in meters which are to be, or which may be, used for recording alternate currents, use pole-pieces, which do not retain residual magnetism, and to effect the object previously attained by the residual magnetism I use an additional coil or coils and an insulated conductor around the pole-pieces of the magnets. The current passed through these additional coils forms no part of the circuit, the current through which is to be measured, but is a branch circuit direct from the main conductor from the dynamo to earth or to the return conductor. The same improvement is applicable to all motor-meters—that is, meters in which the movement is obtained from the current to be measured." The learned counsel said that "branch circuit" there meant an alternative circuit.

His Lordship: Fig. 4 shows that—a current in series from one arm to another.

Mr. Moulton: Yes. "Branch" means that it passes direct from the one main to the other. I do not think that anything can be clearer than those directions. Continuing, the learned counsel said there was no question whatever that the plaintiff tried to get rid of the word "direct." But there was no meaning to the word "direct" except that the current passed, and that was all it did. It went from one main to the other, and formed no part of the circuit the current in which was to be measured. The consequence was that they had got the plaintiff's direction that this current was not to go through the mercury bath. It was to go "direct"—that was to say, it was to do nothing else. There was no question that that was what was meant, and there was no other meaning to the word "direct." What the plaintiff had told people in effect was that you must get a coil connected to your mains, and the current through that must not go through your mercury. What he (plaintiff) did was to imitate the residual magnetism by this additional coil. There was not a hint of change in anything else by the invention. Plaintiff said it related to the 1883 invention, and that he would replace the residual magnetism or substitute something for it, and that the one meter would have the advantages of the other. A man could not claim what he had not invented, nor could he control what he had not invented, and if he (counsel) was right in saying that this invention was solely and absolutely a substitute for residual magnetism by an additional coil, leaving the armature untouched, it was clear that this action was an attempt to control something which did not come under that invention. "The same improvement is applicable to all motor-meters—that is, meters in which the movement is obtained from the current to be measured." He was not, for the moment, on the point of the "current to be measured," as opposed to the "energy to be measured," but when the plaintiff talked of motor-meters he defined them as being those in which the movement was obtained from the current—that was to say, no current, no movement. It applied to meters where there was no source of motion but the current. It was clear that the plaintiff, in his provisional specification, never described any arrangement which completed his motor. All he described was substituting something for residual magnetism. He did not attempt to enlarge the improvement, and he did not attempt to add to the description of the invention. He simply said it was applicable to meters, the source of movement of which was the current. The description he gave was a description of a substitution of an independent coil from conductor to conductor for the residual magnetism. The plaintiff could not go beyond that. When you drew up your patent, you wanted a valid patent, but when you wanted to put it in force you wanted a wide patent. The consequence was, probably, that this patent, which was carefully drawn up, did not include that which was not part of plaintiff's invention, so as to be drawn up in a way which was safe. A person had not the right to go and enlarge it so as to catch an infringer. If his Lordship came to the conclusion that the interpretation of the claim included passing through the mercury, then he (counsel) said it was bad from disconformity, because it claimed something outside the original invention.—If his Lordship came to the conclusion that the actual language used in the claim excluded the completion of the motor, then, of course, there was non-infringement, and the defendants did not care about any of the other points. With regard to the claim, it was settled practice that in considering the claim, you must construe it with the specification. You must read the specification through and come to a conclusion as to the meaning of the documents as a whole. The reason why the current was not to be sent through the mercury bath was to prevent shunt running. The history of the plaintiff's invention was the history of a single substitution. He had never thought of it in any other way. With regard to subject matter, if any portion of the invention claimed was not novel, the patent was bad. There was no invention in substituting an electro-magnet for a solid magnet, because it was common knowledge that residual magnetism was equivalent to permanent magnets. Had the patent been restricted to alternating currents, it would have been a different matter, but you could not interpret it except by including direct as well as alternating. What the defendants did was this—it was admitted that their meter did not infringe the other meter; it was only the question of the coil—they put a second motor on the spindle which gave an absolutely constant tendency to run. It was exactly as if they put clockwork on the spindle which tried to turn it round but was too feeble to do so because of friction. How could they control that? It would be electrically the same thing if they had a second armature as these particular coils. Where was there anything which required any invention in putting a second dynamo on the spindle? Dynamos had been always used for the purpose of turning things round, and he (counsel) did not know what invention was required to do that, putting in shunt coils was as common as possible a thing for producing a constant field—a shunt coil, of course, did not derive its force from the current. It was a branch circuit. It was as common as possible to have a constant magnetic field by means of a shunt circuit. Not only that, it was perfectly customary to mix it with series coils. If the plaintiff was going to say, "You are not to put shunt coils in your motor-meters," surely that could not be upheld. He invented nothing with regard to shunt coils. All he invented was a substitution for residual magnetism. The defendants' was a case in which they had simply put another dynamo on the same spindle. The plaintiff was never thinking of energy meters at all; what he was thinking of, and said he was thinking of, were current meters. He submitted that the fair interpretation of the specification was that it never applied to an energy meter at all. The plaintiff had not in his mind an energy meter; he had not given instructions which fitted an energy meter, and it was only a try-on to make it apply. The plaintiff's could not be an energy meter; and if it were turned into an energy meter his additional coil would be absolutely ridiculous. The learned counsel said that his first point was, that there was in these letters patent one carefully excluded case, and that was the case of the complete motor. His second, that there was no subject matter in any portion of this alleged invention; thirdly, that the specification only applied to meters for measuring current, and not to energy meters. For these reasons he submitted that the defendants had not infringed, and that the plaintiff's patent was bad.

Mr. Cripps, replying on behalf of the plaintiff, said the only serious point was the question of the true construction of the patent, and then the consideration of what had been done as regarded infringement. His learned friend had suggested as part of his case, though he had not pressed it very far, that there was no invention here in the ambit of the specification. Of course, novelty was one of the factors of an invention, and, in addition, there must be an element of research or investigation. Given these two elements, there must always be invention. In this case he need not go very much beyond what Mr. Swinburne had said on the point. Mr. Ferranti, the pioneer of meters, experimented for a series of years until he invented the additional shunt coil for starting purposes, which first made a meter for alternating currents a practical commercial instrument. If it was at all a scientific question, it was clear that he was using the additional shunt coil for starting purposes, and for helping the current when a very low current was running through the meter. It was undoubtedly an invention in the sense of having subject matter to support the patent. Mr. Moulton's argument was that the patent must be construed as limited to the particular illustrations in reference to which Mr. Ferranti gave explanations as regarded construction and matters of mechanical detail. The defendants' answer to this was, that no one could possibly construe a patent of this kind as limited in that sense. It was a patent very much wider than that. The specification stated that the improvement was "applicable to all motor-meters, that is, motors in which the movement is obtained from the current to be measured," and there were other similar passages. It was perfectly clear that both in the body of the specification and in the claim Mr. Ferranti did not intend to limit himself to the particular illustrations, and what was much more important, the proper construction of the claim showed that it had been formed to include all motor-meters with the possible limitation that motor-meters were those in which the movement was obtained from the current to be measured. The inventor who made his claim in that wide form took a risk, and if it could be shown that there were motor-meters in existence at the time to which Mr. Ferranti's invention was not applicable he would fail. But that was not suggested here. Mr. Moulton had talked a good deal about Mr. Ferranti's idea or purpose in making this invention. He might admit that his idea or purpose was to get a substitute in alternate meters for residual magnetism. An inventor who was experimenting with a particular improvement or idea and during his research got a wider result, which Mr. Ferranti did, was not prohibited from claiming that final result and patenting it and getting the patent properly protected. All that argument as regarded the idea of the inventor was beside the point except so far as it might have some inferential bearing upon questions of construction. He used the additional coil or coils to take the place of residual magnetism. There was no doubt the defendants did that. The current formed no part of the current to be measured. There was, no doubt, here again similarity between plaintiff's and defendants' meters. What was the meaning of the word direct in the phrase "direct from the main conductor through the dynamo to earth or the return conductor?" He should have thought "direct" meant from one conductor to the other, or, in other words, it was a loss at the generating station and did not go through the lamps. It was not taken through the armature in the defendants' meter so far as the additional current was concerned for any useful purpose, but merely to save the expense of having a certain amount of additional wire. Mr. Moulton suggested that that in some way got the defendants out of infringement. They took the whole essence of the plaintiff's invention and applied it in what, to them, was the most economical way. They got the whole benefit of the invention, which, of course,

was giving constant increase to what was called a stationary field at least expense by putting it on to the existing shunt coil. One had only to state that proposition to see that it was impossible to get out of infringement by any of these complicated matters about armatures and fields and things of that sort. They were not there on the question of meters or of the difference between current and energy meters. The ambit of the invention was simply this additional coil for starting purposes or for giving additional power when very low current was passing through the meter. Was it arguable that defendants had not taken it. The only possible point that could be taken upon Mr. Ferranti's expression that it was applicable to all motor-meters, was that they had limited motor-meters to meters in which the movement was obtained from the current to be measured, and the only important point in his argument seemed to be whether those words excluded what he had widely called energy meters—*i.e.*, such a meter as the defendants were using. In the plaintiff's meter the movement was obtained from the lamp current. In the defendants' Mr. Moulton said the armature was moved not by the series current nor the lamp current, but by the shunt current. That did not bring about the result that in their motor-meter the movement was not obtained from the current to be measured, because it was, and he did not see where the difference was between the two.

His Lordship reserved judgment.

Atkins & Applegarth *v.* The Castner-Kellner Alkali Company.

In the Court of Appeal on 20th inst., before Lords Justices Vaughan-Williams, Romer and Cozens-Hardy, Mr. Bousfield, K.C., applied on behalf of the defendant company in the case of Atkins and Applegarth *v.* the Castner-Kellner Alkali Company that the plaintiffs' appeal might be struck out of the list on the ground that it had been entered without the leave of Messrs. Atkins and Applegarth. Learned counsel stated that the plaintiffs had authorised the Castner-Kellner Company to take such steps as they could to have the appeal removed from the list. They did not wish to incur liability for costs, and they had not given leave to have the appeal set down. Opposition to the present application was made by third persons, the Commercial Development Company, who said they had an interest in the appeal which entitled them to set it down in the name of Atkins & Applegarth, or to appeal on their own account. The action was brought some years ago by Atkins and Applegarth against the Castner-Kellner Company for infringement of patent, and whilst the proceedings were going on, the Commercial Development Company, of Liverpool, agreed with Atkins and Applegarth to pay them £1,000 down, in consideration of which they obtained an undertaking from the plaintiffs, that they would prosecute the case to a final judgment. They were to pay another £500 towards testing the validity of the patent, and the Commercial Company undertook within two years to float a company, they having a patent of their own which they valued at 17 times the value of the plaintiffs. They were to give to the plaintiffs one-eighteenth of the amount of the proposed company, which was not to be less than £30,000, and under that agreement the plaintiffs were to allow the solicitors of the Commercial Company to have the conduct of the case, that company becoming primarily responsible for the payment of the costs. There was a proviso that the plaintiffs should be at liberty to change the solicitors and conduct the litigation themselves, in which case the responsibility for costs was to revert to them. It was four years ago since the writ was issued, and just before the trial the plaintiffs, having waited three years and finding that nothing had been done with regard to the company, offered to sell to the Castner-Kellner Company such interest as they had left in the patent. They did sell it for £1,000, but the action went on and failed. Notice of appeal was given in the name of Atkins and Applegarth, but they did not want to go on with it, and the question was whether the Commercial Development Company had under agreement such an interest or such a contractural right as entitled them to go on in the name of the plaintiffs or on their own account.

Lord Justice Vaughan-Williams said that if Atkins & Applegarth asked to have their appeal dismissed with costs, the Court would entertain the application.

Mr. Astbury, K.C., for the Commercial Development Company, said that if Atkins & Applegarth served notice of withdrawal, his clients, having an irrevocable retainer, would move in the Chancery Division a motion to restrain them.

Lord Justice Vaughan-Williams said so far as he could make out there were two alleged interests which were in conflict, and it was not right that the Court should be asked to determine the respective rights of the two assignees on such an application as the present.

Mr. Bousfield said he thought he could be instructed to appear for Messrs. Atkins & Applegarth, and perhaps the Court would allow the matter to stand over for a week in order to enable him to consider what had fallen from the Lords Justices.

Their Lordships directed the application to stand over for a week.

The British Electric Traction Company, Limited, *v.* The Commissioners of Inland Revenue.

This case came before the Master of the Rolls and Lords Justices Stirling and Mathew in the Court of Appeal on 20th inst. The appeal was by respondents from a judgment by Justices Kennedy and Phillimore in the Queen's Bench Division in November, 1900.

The Attorney-General, for the appellants, said Mr. Justice Kennedy delivered judgment against the Crown, and Mr. Justice Phillimore in favour of the Crown, although not to quite the full extent. Mr. Justice Phillimore afterwards withdrew his judgment, and finding was accordingly entered against the Crown. The question related to the stamp duty which ought to be fixed to a lease made by the Corporation of Croydon to the British Electric Traction Company, Limited, in respect of certain annual payments, which were reserved by that lease. The payments in dispute were, first, £900 a year, which was accrued due under the fourth clause of the lease; and a payment of £4,000 a year which accrued under the 30th clause of the lease. When the appeal from the Commissioners was lodged before the Divisional Court, there was also in dispute the payments on the main rent, which came to £3,000, but the appeal in respect of that matter was dropped, and, by consent, judgment was given for the Crown on that head. The learned counsel then referred their Lordships to the Stamp Act of 1891 and to the instrument presented on behalf of the British Electric Traction Company, Limited, to the Commissioners for their opinion as to the stamp duty with which the instrument was chargeable. The instrument was an indenture dated January 23rd, 1900, made between the Corporation of Croydon and the British Electric Traction Company, Limited, under Section 19 of the Tramways Act, 1870. It contained a recital that the Corporation was empowered by that Act, with the consent of the Board of Trade, to demise the right of user of the tramways referred to in the indenture, and the right of demanding and taking tolls in respect of the same. Clause 2 specified the terms were for 21 years, and Clause 3 gave the principal rents, as to which there was no dispute. By Clause 4 there was a provision that the Traction Company should pay as from the date of a certificate of the Board of Trade authorising electric traction £100 a year per mile of road along which the tramways were laid, in lieu of maintaining roads and repairing tramways, and this amounted altogether to £900. Clause 27 provided that the Traction Company should purchase all electric energy required for the tramways from the Corporation, and Clause 30 fixed the rate of 2d. per unit during the continuance of the lease, with a provision that so long as the Corporation supplied the energy reasonably required by the company for working the tramways, the minimum sum payable in any one year should be £4,000, with provision for revision of the price charged at the end of the second year. Clause 42 provided for the determination by the company in certain contingencies of their obligation to purchase electric energy from the Corporation, and Clause 44 gave a special power of distress. It was submitted on behalf of the Crown that as regarded the £900, it ought to be charged as rent, and as regards the £4,000 under Clause 30 it ought to be charged under the heading of "Bond Covenant, &c." Mr. Justice Kennedy gave judgment against the Crown on his construction of Section 77, Sub-section 2, of the Stamp Act, his Lordship holding that both Clause 4 and Clause 30 were "covenants relating to the matter of the lease," and were expressly exempted from payment of duty in addition to that charged on the lease. Mr. Justice Phillimore, on the other hand, was of opinion that both the £900 a year and the £4,000 a year were rent, and that the *ad valorem* duty under the heading of lease applied. Proceeding, the learned counsel submitted that the company, in respect of the provisions other than those contained in Clauses 5 and 30, the instrument was chargeable under sub-head 3 of the Stamp Act, as a lease "for an indefinite term . . . . of hereditable subjects where the consideration . . . . money to the lessor . . . . consisted of money, stock or security," with an *ad valorem* duty at the rate of 5s. on every £50 on the rent of £3,250 plus £900, namely, £20 15s. He also held that it was chargeable with the fixed duty of 10s. in respect of the rent mentioned in Clause 5, which was at the date of the indenture unascertainable, and in respect of the minimum sum of £4,000 per annum mentioned in Clause 30 was further assessable under the head, "Bond Covenant, &c." (No. 1), in the same schedule with £135, being 2s. 6d. per cent. on the minimum sum multiplied by 21, the number of years during which the same might have been payable if the tramways had been electrically equipped, and the certificate of the Board of Trade obtained on January 1st, 1900, and if the Corporation had made no default in the supply of electric energy during the continuance of the lease.

Mr. Pickford, K.C., for the British Electric Traction Company, submitted that the right judgment had been given by Mr. Justice Kennedy. He contended that the instrument fell to be charged under the head of "Lease or Tack in the first schedule of the Stamp Act, 1891, under the sub-heading "Of any other kind whatsoever not hereinbefore described," and was liable to a duty of 10s. only. The company was fully protected by Sub-sec. 2 of Sec. 77 of the Act.

At the conclusion of the arguments their Lordships reserved judgment.

Great Northern Railway Company *v.* the Great Northern and City Railway Company.

This case came before Mr. Justice Joyce in the Chancery Division on Tuesday, on a motion on behalf of the Great Northern Railway Company for an injunction to restrain the Great Northern and City Railway Company from entering upon, or in any manner interfering with, for the purpose of laying an electrical conductor, or for running over and using any part of the plaintiffs' railway known as the High Barnet branch, or any other works of the plaintiff company lying to the north of their Finsbury Park station. The undertaking of the defendant company was authorised by Act of Parliament, and by Section 91, the defendant company was empowered to run engines, &c., over so much of the up and down lines of the Finsbury Park and Canonbury branch of the Great Northern Rail-

way as was situate between Finsbury Park and railways Nos. 1 and 2, which plaintiffs contended were south of Finsbury Park station. Defendants claimed a right to carry their running powers on the down line over the High Barnet branch to a spot 33½ chains to the north of Finsbury Park station, and on the up line to a place 26 chains from Finsbury Park. The plaintiffs' reply was that the defendants had no right either to lay down electrical apparatus or to exercise running powers to the north of Finsbury Park. Defendants contended that under the Act the question to be determined should be submitted to an arbitrator appointed by the Railway Commissioners, but the plaintiffs argued that the Act did not provide for arbitration on a point which would extend the powers of the Great Northern and City Railway, although if the defendant company were acting within their statutory rights, it was agreed that the matter could go to arbitration. Defendants further submitted that the motion was misconceived, as they had not threatened and did not intend to enter on the railway. All that they endeavoured to do was to get an agreement with the plaintiffs, and failing that they were going to arbitration.

Mr. Cripps, K.C., Mr. Haldane, K.C., and Mr. P. B. Abrahams appeared for the Great Northern Railway; and Mr. Danckwerts, K.C., Mr. Younger, K.C., and Mr. Hutchinson appeared for the Great Northern and City Railway Company.

In the result, his Lordship held that the cross-over which the defendants were contending for was not part of the works or conveniences of Finsbury Park Station, and granted the injunction asked for until the trial of the action.

Metallurgical Engineering Company, Limited, and Another *v.* The English Electro-Metallurgical Company, Limited.

The hearing of the action brought by the Metallurgical Engineering Company, Limited, and Mr. John Oliver Surtees Elmore against the English Electro-Metallurgical Company, Limited, was commenced before Mr. Justice Wright in the King's Bench Division of the High Court of Justice on 21st inst. The action was brought to recover damages for alleged breach of a contract to allow certain plant, when erected, for the purpose of testing certain electro-metallurgical processes, to remain for a period of three months, rent and access free; also for refusing to continue the working of the plant as provided in agreements dated January 31st, 1896, and September 17th, 1896. There was also a claim for damages for alleged negligence in the custody of the plant and for wrongfully depriving the plaintiffs of it.

Mr. English Harrison, K.C., and Mr. Brooke Little were counsel for the plaintiff company, and Mr. Macaskie, K.C., and Mr. Mackenzie for the defendants.

Mr. English Harrison, in opening the case, said the action arose out of what were known as the Elmore patents, and on an agreement for carrying out certain experiments in order to ascertain whether the process of which the patents were the subject could be made a commercial success. The plaintiff company or syndicate, which had its offices in London, was formed to work the patents in question, and it combined with other small companies for the purpose. Before that there was a company known as Elmore's Wire Company, which had premises in Pontefract Road, Hunslet, near Leeds, where a certain amount of business was being carried on in connection with these processes. Being desirous of carrying the Elmore patents into practical effect, the plaintiff company was incorporated as a syndicate, and an agreement was come to dated January 31st, 1896, between it and the defendant company, then known as Elmore's Wire Company. In that agreement it was set forth that the patentee, Mr. Elmore, was the inventor and owner of certain patent rights and improvements in the electro-deposition of metals, and the mechanical treatment of the same for the production of refined copper, which processes the patentee had offered to the company on certain terms. The company had applied to the syndicate to advance to the patentee the funds necessary to establish the plant, process, and appliances to enable the patentee to demonstrate at the works of the defendant company on a practical scale that there could be produced, to the extent of 20 tons per week, refined unburnished copper. The syndicate agreed to advance £2,000 to be used to provide the necessary plant, and the defendant company agreed to provide or allow the free use of currents from dynamos, &c., and labour; and it was also agreed that the demonstration should be continued for a period of four weeks' actual working, and if in that time 80 tons of refined unburnished copper was produced, the defendant company should then declare that they would, or would not, accept the process. The plaintiff company had advanced the £2,000, and it was expended in purchasing and delivering the plant, &c., required for the process. The defendant company, formed in 1899, took over all the assets and liabilities of the Wire Company, which went into voluntary liquidation, and were consequently entitled to any benefits which might arise from the agreement, and also, as he, Mr. Harrison, should contend, liable under it to the plaintiff company. But the defendant company had not within a reasonable time declared whether they would adopt the process or not, although they had been requested to do so, and had allowed the plant, the cost of which had been provided by the plaintiff company, to get into a ruined condition by neglect. Counsel having read lengthy correspondence which had taken place between the companies, the hearing was adjourned.

Mr. Harrison, proceeding with his opening on 22nd inst., said that at the end of 1897 the process had been successfully worked, and negotiations took place for the amalgamation of the various Elmore patent companies, including the Elmore Wire Company. He should contend that under all the circumstances it must be taken, that although there was no declaration in writing there had been an adoption of the process, within the meaning of the agreement of January 31st, 1896, by the Wire Company which the defendants now represented, and he should urge that the defendants had broken the agreement. There was another possible view, and that was that assuming the process had not been carried out successfully, and that the defendants had not adopted it, then he said the plaintiffs were entitled to have back the experimental plant, on which they had spent £20,000. The defendants, however, would do nothing—hence the present action. As to the plant itself, it appeared to have been so neglected by the defendants that it was now mere scrap. The amalgamation scheme for bringing all the patents into one concern appeared partly to have fallen through. On April 11th, 1899, a meeting of all those concerned took place at the Midland Hotel, London, when the scheme of amalgamation was put before a gentleman resident there, and at that meeting it was stated that the process was successful, and that the proposed new company would possess all these Elmore patents.

His Lordship: What has happened since then? Has the process been found to be a failure?

Mr. Harrison said that owing to the dispute which had occurred the whole thing had been hung up. The defendant company were now, he proceeded, counter-claiming for the plant, and they were asking for a declaration that under the agreement of January, 1896, they were entitled to the benefit of the patents, and also an injunction to restrain plaintiffs from parting with them. The process itself might at present be said to be in a state of animated suspension. After the meeting was held at the Midland Hotel the defendant company was formed, and it thenceforward stood in the shoes of the Elmore Wire Company.

Mr. Macaskie here observed that he should later have an opportunity of contending that his clients were not responsible for the damage done to the plant by the Wire Company.

His Lordship asked that the original agreement should be put in. This was done, and his Lordship said the revenue must be satisfied. It was not stamped.

Mr. Mackenzie said it had been decided that that was not necessary if the agreement was included in the pleadings, as in the present case.

His Lordship: Either the agreement or the pleadings must be stamped.

Mr. Mackenzie said that Mr. Justice Hawkins decided the other way.

His Lordship: But since Mr. Justice Hawkins's time there has been another Act of Parliament, which says that either the pleadings containing the agreement or the agreement itself must be stamped. It was because judges were sometimes considered too ready to grant indemnities that the law was altered. At least, I am told so.

At this stage a lengthy consultation took place between counsel, after which

Mr. Macaskie said there was a difficulty in the way of a settlement being arrived at, as only two directors of the defendant company were in Court. Most of the directors were French, and those who were present did not like to take the responsibility of dealing with what might or might not be a considerable matter. There was no objection to an adjournment.

Ultimately, it was agreed to go as far as possible with the case that day, and his Lordship, as to the stamping of the agreement, said that if the matter was settled it would not be necessary. If the case was gone on with the documents must be stamped.

Mr. Frank Elmore, electro-metallurgist, then gave technical evidence to the effect that the process in question was a success from a commercial standpoint. The experiments which took place at the defendant company's works at Leeds were simply intended to demonstrate this, and they did so.

Witness, cross-examined by Mr. Macaskie, said he had made a number of inventions which had been patented. He was a director of the plaintiff company.

Mr. Macaskie: What is the capital of the plaintiff company? Is it £7?—I don't know.

What! A director, and you don't know what the capital is?—It is merely a nominal capital.

Is it £7, held by seven clerks?—Yes.

In further cross-examination, Witness said he was not able to indicate by name, number, or date any of the patents covered by the agreements of 1896. There had been considerable difficulty in the working of these patents for the depositing of copper on a commercial scale. Before the agreement of January, 1896, the process had not gone beyond the experimental stage. The stock of copper available during the experiments was deficient all through.

Did you not certify that in January, 1896, there was a stock of rough copper on hand worth £17,500, and in February a stock worth £15,000?—Yes.

Then why do you say there was not a sufficient stock of copper?—There was never enough to carry on the business of the company.

Witness, in answer to further questions, said it was not true that the process never produced more than 1 ton of copper per week. The plant was disused after August, 1898, but he saw it once or twice in 1899. He believed the roof of the building containing the plant was taken away in June, 1900—hence its deterioration.

By his Lordship: The defendants smashed up the whole of the machinery and plant in the place of the value of £30,000, and replaced it by machinery from France, in the sale of which a number of the directors were interested.

Mr. Alex. Stanley Elmore, F.C.S., brother of the last witness, and also a director of the plaintiff company, was called, and said there was always a deficiency of copper at defendants' works. The experiments made, however, were completely successful as far as they went.

Mr. Harrison, on the question of damage to the plant, said, in answer to his Lordship, that defendants were bound to take a proper care of it.

His Lordship: Do you mean to say that the plant was deliberately broken up?

Mr. Harrison: I say that the breaking up of the premises was done so carelessly that the dynamos, centrifugal pumps, &c., were damaged by the *débris* being allowed to fall upon it. I would not say that it was deliberately allowed to be smashed.

Mr. Wm. Langdon, M.I.C.E., was also called on behalf of the plaintiff company, and the further hearing was adjourned.

District Council's Powers over Electrical Underground Wires.

The action by Wigham, Richardson & Co., Limited, electrical engineers, Walker-on-Tyne, against the Walker Urban District, and the action by the District Council against Wigham, Richardson and Company, Limited, came on for hearing before Mr. Justice Farwell in the Chancery Division on Tuesday. Mr. Cripps, K.C., M.P., Mr. McMorran, K.C., and Mr. Gatey were for Wigham, Richardson & Co.; and Mr. Robson, K.C., M.P., and Mr. R. J. Parker represented the Urban District Council. After a brief discussion, the case for the Council against Wigham, Richardson & Co. was given priority by the Court.

Mr. Robson, in opening his case, said that his clients were the Urban District Council of Walker, in the county of Northumberland, and the defendants were manufacturers and engineers at Walker; and this action was brought under Section 26 of the Public Health Act of 1875, which enacted that any person who in any urban district, without the written consent of the urban authority, causes any building to be erected over any sewer of the urban authority, or causes any vault, arch or cellar to be newly built or constructed under the carriageway of any street, shall forfeit to the urban authority £5, and 40s. for every day after written notice has been given on behalf of the urban authority; and the urban authority may cause any building, vault, arch or cellar constructed in contravention of this section to be altered, pulled down, or otherwise dealt with as they might think fit, and might recover the expenses of so doing. This was what the defendant company objected to, but the Council maintained that the company having erected a vault, arch, or cellar, the Council were entitled to pull it down or dispose of it as the Council thought fit. The Council were also the public electric lighting authority. In April last it was reported to Mr. Laycock, the Council's surveyor, that the defendants were building, without the consent of the Council, a tunnel under Fisher Street. The defendants' works were on both sides of that street, and they wanted the two sides connected for the purposes of their works. The Council were responsible not only for the sewers which they might hereafter lay down, but also for the electric lighting, if they might wish to lay it down, and they did not wish a tunnel of 12 ft. high put down in this street which might interfere with their own operations hereafter. Notwithstanding that, the defendants persisted in continuing to construct this subway, and while the construction was going on subsidences of the roadway began to take place, and one of the water-pipes was sprung, leaked, and the water began to wear away the soil from under the gas pipes. The Council said that this must not go on, and they claimed the right under the statute to deal with the matter as they thought fit. But the plaintiffs went on with the work to carry their electric mains from one side to the other. Wigham, Richardson & Co. were large shareholders in the gas company, who had powers to supply electrical energy outside this area. Within this area the Legislature had given the Council powers to supply electrical energy, but Wigham, Richardson & Co. took their electrical energy from the gas company at present, and desired to have it extended to the other side of the street—both sides being within the Council's district. The Council submitted that, although they could not prevent Wigham, Richardson & Co. laying this tunnel under their own premises, they could prevent them constructing it under the public thoroughfares. The defendants had filled up the tunnel to some extent, and said that there was no longer a vault or tunnel under the street. But they had not removed the structure. On the contrary, they had left it more dangerous than ever, by filling up the space above the wires with ballast, instead of concrete, or material homogeneous with the surrounding soil or rock. The Council's surveyor advised them that, in consequence, there would be a continuation of the subsidences, and that the Council would be unable to lay drains down this street.

Mr. Thos. Wm. Laycock, surveyor to the Urban District Council, gave a description of the character of the tunnel or arch.

Mr. Cripps, for the company, said that, after all, they only wanted to get at the point of law. The Urban Council seemed to fear that they would lose for electric supply purposes the business of Wigham, Richardson & Co., whose works gave employment to over 3,000 persons. For those works the company wanted to get the polyphase system, and to do that they had to go under the highway; but having had their atttention drawn to the matter, they destroyed the arch, leaving the pipes or wires to pass through the concrete casing. All the District Council were entitled to under the statute was to get rid of the arch, but not to remove the electric wires. Yet they had proposed to dig down and cut those electric wires under the guise of filling up this arch; and against that Wigham, Richardson & Co. got an interim injunction, as they had no right to cut this electrical connection. While the company had been wrong in constructing an archway, and had admitted that, they were still entitled to restrain the District Council from taking up those mains, pipes, and electrical wires; this was now the only bone of contention.

The hearing had not concluded when the Court adjourned for the day.

Easterbrook, Allcard & Co., Limited, *v.* G. F. Milnes & Co., Limited.

Mr. Justice Wright, sitting to hear special cases in the King's Bench Division of the High Court of Justice on Tuesday, had before him the action of Easterbrook, Allcard & Co., Limited, *v.* G. F. Milnes & Co., Limited. The plaintiffs in the action were Messrs. Easterbrook, Allcard & Co., Limited, of Sheffield, and the defendants Messrs. G. F. Milnes & Co., Limited, electrical engineers and makers of electric tramways, &c., of Birkenhead, and the application for the decision of his Lordship was on a point raised by the arbitrator, Mr. Maw, M.I.C.E. Mr. Robert Wallace, K.C., and Mr. Sanderson, were counsel for plaintiffs in the action, and Mr. Green appeared for the defendants.

Mr. Green said the circumstances under which the application was made arose out of an action brought under a contract for the supply of certain machine tools to Messrs. Milnes by the plaintiffs, and the question was whether or not, having regard to the correspondence and conversations which constituted the contract, the defendants were entitled to have only tools manufactured by Messrs. Easterbrook, Allcard & Co. The plaintiffs' original claim was for £1,401, goods sold and delivered, and the arbitrator appointed by the Court reported that he had found that the tools supplied were not all of the plaintiffs' manufacture, but some were obtained from other firms; but that they were manufactured in each case under the supervision of the plaintiffs. He also found that it was a custom in Sheffield for manufacturing firms, such as plaintiffs, to obtain from other manufacturing firms goods contracted to be supplied to their customers. The question now for the opinion of his Lordship was whether, upon the facts, there was a term in the contract that the goods should be solely of the plaintiffs' manufacture. Counsel proceeded to quote from the Sale of Goods Act, and also from the case of Johnson & Rainton to show that when a manufacturer held himself out to supply goods of his own make, he must not act as a dealer and sell goods obtained from others. It was a condition in this case, he said, that the goods should be manufactured by the plaintiffs, and not obtained from Halifax or elsewhere, and such a custom as had been mentioned by the arbitrator could not, he said, be implied in the present case. It might, he said, be a custom to put water into milk, but that would not bind the buyer to accept watered milk. Even though the quality of the goods was substantially the same if they were not manufactured by the seller as undertaken in the contract, the seller could not recover.

Mr. Robert Wallace, for the plaintiffs, argued that the case quoted by Mr. Green and the Sale of Goods Act did not apply. He contended that there was nothing to show that his clients were not dealers as well as manufacturers, and the arbitrator had expressly found that there was a usage existing in the trade to get parts of machinery or tools from other manufacturers, and it was carrying the argument too far to say in face of that custom that the plaintiffs should only supply goods of their own manufacture, especially when the goods were of equal quality. There was nothing in the evidence to show that such a term as was suggested had been imported into the contract.

After some further argument, Mr. Justice Wright said he did think from the letters that were in evidence, or from the plaintiffs' catalogues, which were very voluminous, that they should be debarred from getting portions of the goods from other manufacturers. The arbitrator had found that the machines or tools in this case were manufactured under the supervision of the plaintiffs, and according to plans selected by them. That being so, it seemed to him that any inference which arose from descriptions in plaintiffs' catalogues was satisfied. When they had works conducted on a very large scale, and supplying a vast variety of tools and machines, it would be going too far to infer that all were made by the plaintiffs. It was clear that the business could not be carried on if manufacturers on such a large scale had to manufacture all the parts themselves. That must be common knowledge in many cases, and that manufacturers must frequently be compelled to go to others who made parts of machines wholesale. On these grounds he thought he ought to decide the case in favour of the plaintiffs, and also on the ground that the evidence of usage was admissible.

On the application of Mr. Wallace, he allowed the plaintiffs the costs of the application.

Chamberlain & Hookham *v.* Bradford Corporation.

This appeal case has been occupying the attention of the Court for a number of days both last and this week, and at the time of going to press is still in progress. The continuation of our report, commenced last week, is unavoidably held over until next issue, on account of pressure upon our space.

Mitcham.—It has been decided not to sell the Mitcham tramways order to the B.E.T. Co., but to negotiate for a short lease.

ELECTRICAL MATTERS AT THE LONDON COUNTY COUNCIL.

At a meeting of the Council on Tuesday, the Finance Committee reported having considered an application from the Islington Borough Council for sanction to borrow £5,811 for extensions to mains. It appeared to the chief engineer that the prices generally were higher than those in previous loans to the borough council, but beyond drawing attention to the fact, it was not proposed to suggest a reduction in the amount required. On the recommendation of the committee, the Council decided to sanction the loan.

The Highways Committee, in the course of a lengthy report on the Post Office telephone system for London, stated that the only new feature in it was the application of the message rate system, and then proceeded to review the circumstances which preceded the passing of the Telegraph Act, 1899, and the action taken by the County Council with a view to the provision of a more efficient and less expensive telephone service than that afforded by the National Telephone Company. It appeared to the committee that, by the arrangement now made between the Post Office and the company, one of the objects aimed at by the County Council and the Select Committee of the House of Commons of 1898, namely, general, immediate and effective competition, had certainly not been attained. The arrangements for intercommunication between subscribers to the two systems, while affording some convenience to the public, did not at all compensate for the excessive charges maintained. The committee recommended the Council to forward to the Postmaster-General a copy of their report, with an expression of regret that the Post Office scheme did not establish real and effective competition as recommended by the Select Committee, and did not secure to the public the advantages which it had been led to expect.

Mr. J. W. Benn, in moving the adoption of the recommendation, addressed the Council for over 40 minutes. He stated that he brought forward the report with feelings of very great regret. The Council had laboured for 10 years in order to secure an efficient telephone service at a reasonable charge, and the speaker reviewed the position of telephony during that period. Proceeding to criticise the Government tariff, he submitted that so far as price was concerned it was "Thank you for nothing," whilst in some cases the prices were higher. There was no justification for the proposed charges. In 1898 the Council's comptroller estimated that a telephone service could be provided for £10 per annum for five years, to be reduced to £9 afterwards if possible. The prospectus of the New Telephone Company in 1892 promised an unlimited service at £12 12s. per annum with free inter-communication with the system of the National Telephone Company, and the estimate of the cost of establishment was £38 per wire, or the same as that of the County Council. It was, therefore, ridiculous for the Postmaster-General to say he had done his best for London at £17 per annum, and other reasons must be looked to for an explanation of the high charges. The company, which had a capital of £7,000,000, had been unable to collect dividends in the provinces and had therefore obtained the whole of its dividends from the London area. Another reason why the Post Office had joined hands with the company was because it was very much alarmed at the decrease in the revenue from the telegraph service. The cat had been let out of the bag that morning by the announcement of the retirement of Mr. J. S. Forbes and the intended acquisition of the company's London plant in 1911. The speaker wondered why the Post Office had not had the decency and honesty to inform the County Council of the fact; they wanted to know why the undertaking should be purchased and at what price. It was impossible to comment too strongly upon the procedure adopted in the matter. The County Council had thought that a good thing was coming, but the whole affair had been handed over to the company, and the Council had been betrayed in the matter. Since September the company's shares and stocks had appreciated to the extent of £366,000, and it was evident certain persons had known of the arrangement for some time, but the County Council had only been informed last week. It might be necessary to consider the question of approaching the Government and offering to buy the Post Office system, and work it for the benefit of London.

Earl Russell, in view of the fact that many members might desire to discuss the question, proposed an adjournment of the debate for a week, and this was carried.

The report of the Highways Committee reminded the Council of the recent acceptance of the tender of Messrs. J. G. White & Co., for the execution of the roadwork and plate-laying required in connection with the reconstruction of the tramways between Westminster Bridge and Tooting. That firm had now asked for permission to sublet to the Anderston Foundry Company, of Glasgow, the manufacture of the cast-iron yokes and road boxes and other ironwork, and on the recommendation of the committee, the Council resolved to allow this to be done.

Stroud.—While Mr. T. Nevins fully intends to carry out the entire scheme of connecting Stroud with Gloucester, Cheltenham, Painswick, Chalford, Stonehouse and Nailsworth by a network of electric railways, he cannot get the full particulars of the scheme prepared in time to apply for an order this month. He proposes to obtain an order for a part of the scheme, and to give an undertaking to make further application in respect of the remainder of the route next year.

CORRESPONDENCE.

[Note.—*From time to time we receive letters for our "Correspondence" columns which are unaccompanied by the names and addresses of their authors. We therefore remind our correspondents of the universal rule that such letters are not inserted.*

Moreover, letters should be written on one side of the paper only, and should reach us not later than Wednesday morning.]

L.C.C. Contracts.

May I call your attention to the enclosed* list of tenders just forwarded to us.

I have marked the names of the only three firms who, so far as I am aware, have carried out similar work in fire stations recently for the L.C.C., and who by this time should know very accurately the *cost* price.

My own estimated costs taken from the actual figures, very carefully recorded, of three similar fire stations we have ourselves fitted within the last 15 months, and allowing for the various differences and modifications, show clearly that the amounts of the tenders now accepted are not more than about half what the job may be expected to *cost* in each case—in some cases less than half. It seems pitiful that such tendering can obtain, as it can benefit no one in the end.

At a first glance at the list it might seem that the three previously successful tenderers having had "a taste of it," had decided not to be "successful" again. But as a matter of fact, we had to pay for our specifications, and there cannot be a doubt that we made every effort to be in the running, especially as still closer competition had to be expected with these advertised contracts.

H. Dudley Barlow.

November 22nd, 1901.

[*This list was published in *our last issue*.—Eds. Elec. Rev.]

Multiplicity of Tenders.

We consider that your leading article and the subsequent letters on the subject require the attention of all electrical and mechanical engineers, both consulting and manufacturing, and we feel sure that it would be to the advantage of all concerned if some satisfactory arrangement could be arrived at whereby the excessive and costly system of cross tendering could be avoided. What a task the engineers must have had, in unravelling and reporting on the three hundred and odd tenders the London County Council recently received in connection with their tramway scheme! The amount of time and energy given thereon must have been enormous. Surely, something can be done in connection with the matter which will relieve all parties.

Yates & Thom.
W. Thom, Jun.

Blackburn, *November 20th*, 1901.

10,000-Volt Shock.

I notice that you have a paragraph in your issue of November 8th referring to a 10,000-volt shock at Mascara, Algeria. I do not know who was responsible for the account, but although it has appeared first in the daily Press, I have to say that for once in a while the occurrence has been correctly reported. The installation is a 20 miles three-phase transmission of power at 10,000 volts, which my Liége principals put down at Mascara some years ago. The engineer, M. Viel, who received the shock, is one of the men my firm sent out to erect and look after the plant. The matter is, of course, the subject of an official inquiry at the moment, but there appears to be no doubt that the shock was given through the telephone wire, and was caused by a dissatisfied workman connecting the telephone wire with one of the line wires. From the advices my firm have received, the engineer was burned very badly on his left side, and was unconscious for 11 hours; he is now, however, progressing satisfactorily. If he does pull through, he will probably be the only person who can boast of having received a 10,000-volt

shock and survived. I may mention that there is absolutely no question of the voltage, as the 10,000 is generated directly by our three-phase generators.

The International Electrical Engineering Company,

E. Kilburn Scott, *Engineer and Manager.*

The De Beers Contracts.

I enclose a copy of a letter I am forwarding per this mail to the *British and South African Export Gazette*, also a cutting from their issue of October 4th. I shall be greatly obliged if you can see your way to giving publicity to this correspondence in your columns.

My chief reason for my original communication to you was to correct the misstatements, with regard to the placing of contracts, and the "Alleged superiority of American machinery for mining purposes," which I consider injurious to the British export, mining, and electrical trade with this country.

I may also add that my surmise as to the placing by the De Beers Company of the cable contract in England has proved correct, as this contract has been given to the British Insulated Wire Company.

Granville Vines.

Electrical Engineer's Office,
Kimberley Borough Council,
October 26th 1901.

October 26th.

To the Editor,
British and South African Export Gazette,
Leadenhall Street, London, E.C.

Sir,—I have to thank you for the marked copy of your journal of October 4th, in which I am surprised to find myself severely taken to task for denouncing the *British and South African Export Gazette* in a letter contributed by me to the Electrical Review.

I would point out to you that my alleged "denunciation" consisted in simply correcting a series of misstatements, which derived their sole importance from having been copied by the Electrical Review, a Journal which, unlike your own, is very widely read by the profession to which I belong. I should not feel it worth my while to correct any inaccuracies, on matters electrical, which appeared exclusively in your columns.

I hope this explanation will be satisfactory, and that you will acquit me of any intentional discourtesy in addressing my communication to the Electrical Review.

Your somewhat ill-tempered personal allusions to myself, being quite gratuitous, I pass unnoticed.

I am, Sir,
Yours faithfully,
Granville Vines, A.M.I.E.E., A.M.I.Mech.E.

[The statements referred to were made in the July issue of the *B. and S. A. Export Gazette*, and were abstracted by us, with acknowledgment of their source. They were to the effect that (1) The De Beers Consolidated Mines had practically completed their arrangements for a great extension of their electric light and power system; (2) a part of their scheme included the taking over of the existing plant of the Kimberley Municipality and the supply to the town of the electric light at net cost; and (3) the huge orders for the installation would in all probability go to America. The last two statements were contradicted by Mr. Vines, in a letter addressed to us, and the *Gazette* published an article in a recent issue in which our esteemed correspondent was very roughly dealt with.—Eds. Elec. Rev.]

Electrical Contracting and its Abuse.

Although, according to the classification of the divisions of debate put forth by "Business, not Starvation" in his last letter, I am afraid I am out of order in replying, yet I feel that there is at least one point in your correspondent's letter that is somewhat misleading, so I crave your indulgence, Sir, that it may be cleared up. I am credited by your correspondent with jumping to conclusions. Now, Sir, I think you will agree with me that my grounds for so doing were ample, and it was only natural under the circumstances that your correspondent's protest against the coercion of the people who abuse trade discounts (which, by the way, he still makes), should have been construed as a defence of that practice. On the other hand, I hope you will not think me unkind if I venture to suggest that as regards jumping to conclusions, the shoe appears to be very much upon the other foot. For instance, I am quite at a loss to know how your correspondent arrived at the conclusion that because the wiring of a job does not show a profit, of a certainty it must be a loss. I am afraid that your correspondent has not quite grasped the situation when he suggests buying for a 1s. and selling for 11¾d. as my rendering of the word competition; it is certain that in none of my letters have I suggested such a practice, nor do I know of any contractor who is so foolish or so anxious to visit "Carey Street" as to do this. Surely "Business, not Starvation" can conceive a position where, owing to the amount of competition and cutting of prices, a contractor has to bring the price for wiring down to a trifle above cost, the surplus being so inconsiderable as to be scarcely deemed a profit, and even then liable to be lost as a result of a workman's carelessness or incapacity. Evidently "Business, not Starvation" is not a contractor, else he would well know how very easily profits on wiring can be lost or greatly reduced by circumstances that it is impossible to foresee. The contractor, being only human, and not gifted with second sight, or with the ability of the seer, consequently is often the victim of circumstances, and as such, sometimes finds that the profits which he anticipated have considerably shrunk in the process, and 'tis then he looks to the fittings to recoup himself. It is also argued by your correspondent that the sale of fittings should not be subject to coercion, or in other words, the abuse of trade discounts should not be prevented until the abuse of electrical contracting has ceased to be. Here is a pretty case of cause and effect, and your correspondent wishes to remove the effect and leave the cause, an idea worthy of a philosopher. As I pointed out in my last letter, the competition, which is at the root of the abuse of electrical contracting, is wholly and solely the result of the abuse of the trade discounts, which enables the men of whom I spoke to rank on a par with genuine electrical engineers. *Ergo*, when the cause as represented in the abuse of discounts is removed, then as a natural sequence the abuse of electrical contracting must cease. Quite a simple case of cause and effect, isn't it? Might I say further, that I believe the question of the contractor who also manufactures has been discussed by the Electrical Contractors' Association (to which I presume the sentence refers), and I have no doubt that information would be given upon that matter if your correspondent were to make application. With apologies to you, Sir, for having taken up so much space—

Sidney Frost.

Examination Test for Electrical Engineers.

It has been a great pleasure to me to follow the interesting correspondence appearing under the above heading. Before closing the subject, I beg to be permitted to make a few remarks.

In reply to "Justitia," I regret to say that it is quite possible to get a good man at a small salary. There are in the profession of electrical engineering many "human" boosters who are willing to serve for a time under unqualified men in the sad and delusive hope that at the proper time they will be requited for their services in the usual manner. It may be said, almost without fear of error, that they are foredoomed to disappointment. It is to the "human" booster, as much as to the venial practice of men who sit upon some (not all, thank Heaven) electricity committees, and the members of our profession, who abuse their positions, that we have to look when we view the present unsatisfactory state of affairs.

In one particular I wish to make myself clear. I am not one who looks upon the time spent upon a switchboard as wholly unnecessary. For the proper training of an engineer, it is absolutely necessary that for a year or two at least he shall have charge of heavy running machinery. When I say "charge of running machinery," I mean *actual* and not merely *nominal* charge. I know that this will be exceedingly tiresome reading for many young men who languish upon the switch promenade, and drawl from time to time, in the language of the "used-up," requests for the fitter to look after that beastly thing. They will, however, find it far more tiresome, and not a little humiliating, when they are called upon by some "live chief" who is no fool, to show the

men in a practical manner what requires to be done. Then it is they give the ordinary wireman pause, what time the fitter's boy chortles in his mirth.

May I be permitted to make a practical suggestion? There are many eminent engineers willing to give their services. All that is necessary is that they should be approached. I have myself spoken to one or two, and they warmly commend the movement. If those who are anxious to benefit would be willing to defray the expenses of printed matter for "circularising" corporate bodies, and calling their attention to the movement and its objects—a few stamps from each member would be sufficient—and if a representative committee to deal with the matter were chosen from the members of the profession, preferably within the London area, something practical would come of it. Would Mr. Fogarty, or some of our London members, be willing to receive the names of those anxious to participate in and advance the matter for our common benefit? If so, he or they will have the name of the humble individual who signs himself

The Booster of the Middle Wire.

Horse-Power Meters.

I notice in your current issue a description of an ammeter calibrated in horse-power for constant voltage, made by Messrs. Everett, Edgcumbe & Co. With regard to the novelty, I think there is hardly anything fresh in this arrangement, as I have seen many instruments so calibrated and in use as horse-power meters in the last few years, made by Nalder Bros. & Thompson, Limited, and others.

A. F. Harris, A.I.E.E.

Brixton, *November 25th*, 1901.

oal Consumption per Unit in Power Stations.

I cannot quite agree with Mr. Booth's definition of station load factor, when he says the maximum load is to be taken as the highest momentary reading permitted by the circuit breaker.

When applied to lighting stations it is, I believe, usually expressed as $\frac{\text{Units} \times 100}{\text{Max. load} \times \text{hours}}$; such is the case in *Lightning*, as everyone is aware who is accustomed to peruse its table of costs.

I have never seen it expressed when applied to a traction station, except by Mr. Booth. Consequently, I should like to see the opinion of others on this knotty point.

For my part, I think the highest momentary reading of the recording ammeter is to be preferred.

In specifications for traction plant it is customary to ask for generators which shall be capable of running so many hours at 25 per cent., and for some short period at 50 per cent. overload.

It would, therefore, appear reasonable to expect that the circuit breaker of a 200-KW. generator could be safely set at 600 amperes.

If in a station where four such sets were installed, two were on load, and the highest momentary reading of the recording ammeter showed 900 amperes, it would make a great difference in the load factor if it were calculated from the setting of the circuit breaker in preference to the recording ammeter.

On the other hand, if the setting of the circuit breaker is brought lower, lively times may be expected on the switchboard.

I have calculated the station load factor by highest momentary reading of the recording ammeter, and also by the ratio of units generated in a certain time by the plant working, to the station output at full load for a similar period, and found very little difference in the results.

This would very likely not do in other stations, for the reason that the traffic may be differently arranged.

The frequency and regularity of service have a great effect on the station load factor, as can be gathered by the fact that our load for more than three-quarters of the whole run rarely ever varies more than 25 per cent. above or below a certain output, and this fact makes the plant load factor in our case of great value, for it means that 50 per cent. of our plant is capable of generating 50 per cent. of the total output of the station for a similar period and same conditions of load.

I think this has escaped the notice of Mr. Booth, as he evidently thinks it requires more than 50 per cent. of the plant to generate 50 per cent of the total output.

Our plant load factor being something like 100 per cent. (as can be gathered from the foregoing statement) there is bound to be economy in the coal consumption.

As our load is nearly the same every day, the coal consumption works out, as I have stated, under 3 lbs. per unit, including steam used in auxiliaries, which are steam-driven, but which in our case are very few, electrical driving being used as much as possible.

As regards vacuum, I took the average figure in this case as 28 in., and 28½ in. are as usual as 27½ in.

I regret I am unable to send a strip of the output by recording ammeter, as I am sure it would show just what I have stated, but if I get permission I will be very pleased to do so.

W. H. J.

Poplar Union Electrical Works.

We are glad to hear that Messrs. Fuller, Wenström & Co. have so much confidence in their motors, and hope they will be able to arrange an independent test. We do not consider Mr. Warden Stevens an independent expert, but would suggest the editor of the Electrical Review for this duty; the machines to be tested in the presence of a representative of the motor makers, the consulting engineer, and ourselves.

Under these conditions we should be pleased to accept the challenge, and agree that if the motors are up to the specification we will pay £5 to Poplar Hospital, and if not, the motor makers pay a similar sum, the losing party to pay the fee of the independent expert.

We, of course, understand that each party quoted from the same specification.

Stephens, Smith & Co., Limited.
John Stephens, *Managing Director.*

November 26th, 1901.

The E.E. Vols. Christmas Gifts.

It may interest those of your readers who have so liberally subscribed to the fund for sending presents to the electrical engineers in South Africa to know that as a first consignment a parcel has been sent by post to every man, containing plum pudding, chocolate, tea, a pipe and tobacco, which should reach them by Christmas.

With the balance of the fund collected further stores will be purchased and forwarded with the fourth detachment, who are shortly leaving for the front.

A. H. Pott,
Capt. E.E.R.E.V.

BUSINESS NOTES.

Books Received.—"Science Abstracts" for November 25th (No. 47). London: E. & F. N. Spon, Limited. 2s.

"Méthode Pratique pour calculer les Moteurs Asynchrones Polyphasés," by Boy de la Tour. Paris: Ch. Béranger. 1902. fr. 12.50.

Damages for Shock.—Judge Greenhow, at the Leeds County Court on 20th inst. awarded a painter, named Schnidler, £50 damages against his employer, a master painter, for injuries sustained whilst following his employment. He was painting the walls of the English Electro-Metallurgical Company's works at Hunslet, and came into contact with a 600-volt wire, which he alleged was not properly guarded. It was stated that he was still partially paralyzed, and would not completely recover for another three months.

An Exhibition in the Bahamas.—We have received certain particulars regarding an exhibition which is to be held in the Bahamas on February 10th, 1902, and for 10 days thereafter. It is being arranged under the auspices of the leading professional and business men of the Colony, and is suggested as a chance for manufacturers to bring their goods before the people of the islands. The organiser is the Rev. F. W. Gostock, of Trinity House, Nassau, Bahamas. Mr. F. E. Potter, of 56, Ludgate Hill, E.C., is also in a position to afford information.

Electrical Wares Exported.

Week ending Nov. 27th, 1900.		Week ending Nov. 26th, 1901.	
Adelaide. Teleph mat. ..	Value £500	Amsterdam	Value £83
Alexandria	78	Auckland Teleph. mat. ..	57
Amsterdam	107	Azores. Teleg. cable	1,000
Beira. Teleg. mat.	150	Bombay	318
Bilbao	402	Calcutta	2,209
Bombay	425	Cape Town	1,414
Buenos Ayres	84	,, Teleg. cable ..	516
,, Teleg. mat. ..	81	Christiania	20
Calcutta	860	Colombo	125
Cape Town	393	,, Teleg. mat.	204
Christchurch	223	Copenhagen. Teleg. wire ..	144
Colombo. Teleg. mat. ..	101	Durban	127
Copenhagen. Teleg. wire ..	141	Fremantle	906
Durban	201	Hamburg	142
East London. Teleg. poles ..	259	Hong Kong	22
Fremantle	12	Kobe	21
Gibraltar	16	Rotterdam. Teleg. wire ..	60
Hamburg. Teleg. mat.	800	Singapore	108
Kariskrona. Teleg. wire ..	107	Stockholm. Teleph. cable ..	250
Lisbon. Teleg. mat.	40	Wellington	529
Manilla	27	Yokohama	3,985
Melbourne	51	Yokoska	3,846
,, Teleg. mat.	305		
Montreal	150		
Nagasaki	60		
Newcastle	32		
Ostend	1,093		
Port Elizabeth	153		
Port Said	125		
Rosario	457		
Rotterdam. Teleg. wire ..	59		
Shanghai	185		
Singapore	36		
Stockholm. Teleg. wire ..	16		
Sydney	979		
Trieste	23		
Wellington	25		
Yokohama	88		
Total ..	£8,344	Total ..	£16,086

Foreign Goods Transhipped.

Durban. Teleg. mat. .. Value £228

Bankruptcy Proceedings.—The affairs of Johnstone, Benjamin & Co., manufacturers of electric wires and cables, 10, Ascham Street, Leverton Street, Kentish Town, came before Mr. Registrar Giffard on Thursday at the London Bankruptcy Court. The debtors failed last January with liabilities £7,480 7s. 8d. ranking against assets expected to produce £5,912, and the creditors subsequently accepted a scheme providing for the payment of a composition of 10s. in the £. The arrangement now came before the Court upon an application for its approval, and the Official Receiver reported that its terms appeared to be beneficial to the general body of creditors. Upon the case being called, Mr. Osborn (Osborn & Osborn) asked to be allowed to withdraw the application on the ground that his clients were not prepared to carry out its provisions. The reason for that step was that the Official Receiver had filed his report opposing it, although he regarded the terms as beneficial from the creditors' point of view, and the trustees had lodged a motion against Johnstone, Benjamin and Co., Limited, to set aside the transfer of the business to that company. Terms had been arranged under that notice of motion before Mr. Justice Wright, and consequently the debtors could not carry out the scheme which was the subject matter of the present application. His Honour said the only order he was empowered to make was to refuse to sanction the scheme, on the ground that the debtors were unable to proceed with it. Order was accordingly entered in those terms.

Dissolutions and Liquidations.—A meeting of Messrs. Nalder & Hilton, Limited, is to be held at 14, Bedford Row, on Saturday, December 28th, to hear an account of the winding-up from Mr. A. E. Darville, liquidator.

Messrs. R. C. D. Pullin and A. E. Morgan (Pullin & Morgan, electricians, Newport, Mon.), have dissolved partnership. Mr. Pullin will attend to debts.

The Clayton Engineering and Electrical Construction Company is winding up voluntarily, with Mr. M. Whiteley, 17, Knight Street, Hyde, as liquidator, for the purposes of reconstruction. The new company will be known as the Clayton Engineering and Electrical Company.

A meeting of the Coventry Gas Fitting, Electrical and Engineering Company is to be held at Queen's Hotel, Coventry, on December 31st, to hear an account of the liquidation from Mr. T. M. Daffern, liquidator.

Catalogues, &c.—Messrs. Griffiths Bros. & Co., of Bermondsey, have issued a new circular, giving particulars of their various manufactures for electrical purposes, including "Armacell" insulating varnish for stoving purposes, "Discum" varnish for coating discs, "Armalac" air-drying insulating composition, and "Ferrodor" filler for castings.

Messrs. Naylor Bros., of James Street, Oxford Street, W., have sent us lists of their ornamental flat back for art metal workers, lacquers for electricians, also acid-proof paints and enamels.

From Messrs. Ludw. Loewe & Co., Limited, of Farringdon Road, E.C., we have received copies of their very convenient and finely got-up pamphlets. "A" deals with chucking; "B" gives notes on foundry practice; and "C" is devoted to a discussion of limit gauges.

A new list of protected rheostats and measuring instruments has been brought out by Messrs. Isenthal & Co., of Mortimer Street, W.

A revised list of enclosed motors comes to hand from Messrs. Crompton & Co., Limited. The outputs of machines have been altered and improvements introduced, whilst most of the prices show reductions.

Messrs. Crompton & Co. have also thoroughly revised the price list of their various patterns of arc lamps, and made considerable reductions in several important particulars. A preliminary sheet gives the prices of their "P" and "S" open-type lamps, and of the "Chelmsford" enclosed lamp, and a complete arc lamp catalogue is to be issued in the course of a few weeks.

The I.R., G P. and Telegraph Works, of Silvertown, have forwarded to us illustrated lists of their Rymer-Jones's testing keys, and patent connectors for electrical testing. These latter are illustrated elsewhere in this issue.

List No. 113 of the B.T.H. Co. is devoted to a consideration of magnetic blow-out lightning arresters for direct current.

A revised wholesale price list of electric bell materials and novelties has been issued by Messrs. Julius Sax & Co., Limited; a list of wall-plugs and tumbler switches also shows reductions.

Electric Wiremen.—We are requested to state that "all competent workers wishing to join the new Electrical Wiremen's Association are requested to attend a meeting to be held at the Alma, Parson's Green Lane, Fulham, at 7.30 p.m. sharp, on Sunday next, December 1st, 1901."

For Sale.—Messrs. Percy Huddleston & Co. will on Friday, December 6th, offer for sale by auction the electric supply plant of the Empire Palace Theatre, Edinburgh. See advertisement pages to-day for details.

The Electricity Supply Works, Cults, is being offered for sale as a going concern by the liquidators of P. C. Middleton & Co., Limited.

Football.—The annual match for the Lamp Makers' Challenge Cup was played between the "Robertson" lamp makers and the "Ediswan" lamp makers last Saturday at Ponder's End. For the third year in succession the "Robertson" lamp makers succeeded in winning by 3 goals to 2, the cup thus becoming the property of the "Robertson" lamp makers, until re-taken by any other lamp makers' football club.

Transmission of Power in Collieries.—Messrs. Ernest Scott & Mountain, Limited, of Newcastle-on-Tyne, have just arranged an important contract with the Broughton and Plas Power Coal Company, Limited, near Wrexham, for an important extension to the installation which they supplied some time since for the Plas Power Colliery, the original consisting of two sets of horizontal compound engines of 350-H.P. each, driving by ropes two Scott & Mountain generating dynamos of 200 KW. capacity each; power is taken from these two generators to the electric motors underground for driving haulage gears and pumps. The haulage gears are dealing with 1,300 tons of coal per day, and the pumps delivering 200 gallons per minute against a head of about 900 ft. The extension plant which Messrs. Scott & Mountain have now in hand consists of one of their vertical two-crank, enclosed, compound self-lubricating engines of 350 H.P., coupled direct to one of their 200-KW. six-pole dynamos of the continuous-current type, and the new plant will supply current to the Gatewen Colliery, about 2,000 yds. from the generating station, for driving the underground haulage gear there, which is a distance of about one mile in-by, the motor for driving this gear being of 200 H.P. The company's object in adopting electrical machinery has been to concentrate the whole of the power in one central station at Plas Power, and distribute current to the various collieries for driving pumps, haulage gears, &c.; the extremely satisfactory results of the first plant have induced them to make extensions as described above. Messrs. Scott & Mountain also inform us that they have just settled a very important pumping contract with the Ashington Coal Company for their Woodhorn Colliery, this plant consisting of one of the firm's multipolar continuous-current dynamos of 270 E.H.P., driven by a horizontal long-stroke compound engine. This generator will supply current to four electric motors, each driving a three-throw ram pump, also of Scott and Mountain's manufacture. The first set of pumps are for main shaft pumping and deliver 400 gallons per minute against a head of 600 ft., the second set of pump shafts delivering 150 gallons per minute against 350 ft. head, and two smaller pumps for dip workings, each delivering 100 gallons per minute against 100 ft. head. The same firm are supplying the complete electrical generating plant for Messrs. Pease & Partners, Bankfoot Colliery, Crook, for driving coal-cutting machines, &c., this plant consisting of a long-stroke compound engine of 350 H.P., and the generating dynamo is capable of giving an output of 270 E.H.P. at the terminals. The large pumping plant which the same firm have had in hand for the South Durham Coal Company, Bishop Auckland, is now nearing completion. This plant consists of a horizontal long-stroke compound engine of 450 H.P., driving a 250 KW. generator, which supplies current to two sets of main shaft pumps; each pump delivering 500 gallons per minute against a head of 400 ft., or collectively 1,000 gallons of water per minute; each pump is driven by one of the same firm's electric motors of 120 H.P. Messrs. Scott and Mountain have also a very large amount of work in hand all over the United Kingdom, as the advantages of electricity for transmission of power are now being greatly appreciated by the various colliery owners and managers.

What the British Consuls have to Say.—*Telegraph and Telephone Services in Trinidad and Tobago.*—Acting Colonial Secretary H. Clarence Bourne reports that there are 32 telegraph offices in the Colony of Trinidad and Tobago. The inland telegraph service is conducted by the Railway Department. Trinidad is connected with New York, *vid* Jamaica, by the cable of the West India and Panama Telegraph Company, which receives a subsidy of £3,000 a year. Telegrams to England can be routed from Jamaica *vid* Bermuda and Halifax, thus passing through British Colonies only. The rate per word to England is for the public 5s. 1½d. News

telegrams are supplied daily from New York. There are three telephonic agencies at work connecting the outlying parts of Trinidad with the capital. Tobago is, at present, unconnected with Trinidad, but the feasibility of establishing regular communication between the two islands by wireless telegraphy is now under consideration. The capital of Trinidad, Mr. Bourne remarks, possesses in the way of shops, electric light, telephones and clubs, the resources of a civilised town.

Telephone Service in Hong Kong (New Territory).—Colonial Secretary J. H. Stewart Lockhart, in his report on the Hong Kong New Territory for 1900, states that telephone communication has been extended to the temporary Police Station at San T'in, and also to Shat'aukok, so that the telephone communication between the various Police Stations in the New Territory and with Victoria is now complete.

Telegraph Service in the Mauritius.—According to the annual report of the Governor of Mauritius for 1900, there are 51 telegraph offices in Mauritius, and an annual subsidy of £8,000 is paid to the Eastern and South African Telegraph Company in respect of their submarine cable from Mauritius to Seychelles and Seychelles to Zanzibar. Of this sum £7,000 is borne by Mauritius and £1,000 by Seychelles.

The Cordoba Light and Power Company, Limited.—This company, according to the report of Vice-Consul D. Munro on the trade of Cordoba (Argentine Republic) for the year 1900, was formed on March 30th, 1896, in the City of Portland, Maine (United States), to acquire the right of utilising the water force of the Rio Primero, in Cordoba, with an authorised capital of $1,000,000, divided in 10,000 shares of $100 each. The company took over a concession which was granted by the Cordoba Government in 1893 to Messrs. F. Mackinlay & Co., of the right to use the waters of the Rio Primero, in the part of its course comprised between the tunnel of the Cordoba and North-Western Railway, and a point about 3 miles above the Mal Paso dam, for generating electricity, and conducting it by cables to the City of Cordoba, about 18 miles, and any other points in the valley of the River Primero, having the right to cross all fiscal lands with their cables, without paying rent or indemnity. The term of this concession was fixed at 25 years, counting from the date of commencement of the construction works. In compensation for the concession granted, the Cordoba Government is to receive, during the last 10 years of the contract, 5 per cent. of the net earnings of the company, and has reserved the right to acquire the property at the expiration of the contract by purchase at a valuation plus 20 per cent. of the value so determined. If the Government should not take advantage of the right of purchase, the company will continue to work the property, paying the Government 5 per cent. of the gross receipts during the first five years, this proportion to be increased by 5 per cent. every five years until a maximum payment of 30 per cent. of the gross receipts shall be reached. The company is exonerated from payment of municipal taxes for a period of 10 years. The president of the company is Mr. T. N. Vail, of New York, and the legal representative in the Argentine Republic is Mr C. R. Thursby, of Buenos Ayres. The system of the plant is alternating current at 60 cycles, having a voltage of 10,000 volts at Bamba, brought down to 2,000 volts at the transformer station in Cordoba for the city lines, and afterwards again transformed down to 115 volts for the houses.

Electric Light and Power at Bamba and Cordoba (Argentine Republic).—The present installation at Bamba, Vice-Consul Munro states, gives 1,500 H.P., but the Cordoba Light and Power Company, Limited, referred to in the previous paragraph, is adding a further installation of the same amount, thus bringing the total saleable power to 3,000 H P. This still leaves room for a third flume-pipe which, when added, will increase the power to 4,500 H.P. The company supplies power to some 52 factories, bakeries, mills, &c., the motors thus in use giving an aggregate of about 550 H.P. The company also supplies power to a new carbide factory for heating its ovens. There are about 700 to 800 private houses, shops, &c., lighted by electric light in Cordoba, giving a total of about 8,500, equivalent to 16-C.P. lamps. The streets of Cordoba are lighted by 230 municipal lamps, 90 per cent. of which are 2,000-C P. direct current arc lamps, the current being changed from alternating to direct by means of synchronous motors and dynamos in the company's works at Cordoba.

Those Who Construct Electric Plant, Vice-Consul Gray (Carthagena) remarks, may be interested to know that a large company has been formed for the purpose of supplying light and power to Carthagena and the mining district. Most of the shares are owned at Bilbao, where the company's headquarters are, but the shares offered to Carthagenians were immediately taken up. The company's great hope is to do away with steam power for working the mines, supplying instead electricity.

Proposed Electric Tramway between Almeria and Berja.—According to the report of Vice-Consul Lindsay, there is a scheme on foot for an electric tramway to run between Almeria and Berja in the consular district of Malaga (Spain).

ELECTRIC LIGHT AND POWER NOTES.

Barrowford.—Mr. W. A. Fraser, the borough electrical engineer of Nelson, has been appointed consulting engineer to the Council for the tramways and lighting.

Birkenhead.—A reduction in the charge for electric current for lighting has been made. On the reduced basis the cost to consumers averages 4·28d. per unit, against 5·55d. recently.

Brierfield.—Mr. W. A. Fraser, borough electrical engineer of Nelson, has been appointed consulting engineer to the Council for tramways and lighting.

Bristol.—In last week's ELECTRICAL REVIEW a summary was given of the new powers the Bristol Corporation are asking Parliament to confer on their electrical undertaking. Among other provisions are clauses entitling the Corporation to go outside the municipal area to supply electricity. Since then the Barton Regis Sanitary District Council, which exercises jurisdiction over a number of these outer areas, has given notice of a Bill to provide for its own electrical wants. Speaking at a Council meeting on Tuesday, Alderman Pearson said they had had applications for current from these outlying districts, and expected more of them. The Electrical Committee, however, had no intention of exploiting them to their detriment; if these areas said the Committee could be of no service to them, the Committee did not seek to force themselves on such districts. The Council adopted the Electrical Committee's proposals.

Chepstow.—The E.L. Company has fixed a maximum charge of 7d. for lighting and 5d. for power. The U.D.C. now approves of the application for a prov. order.

Derbyshire and Notts.—An amending Bill is to be introduced in Parliament next Session on behalf of the Derbyshire and Nottinghamshire Electric Power Company, by which the company will seek to remove the restrictions in their Act prohibiting the erection of stations for generating electricity elsewhere than on the lands described in that Act. They seek power to erect stations on any lands which for the time being belong to them, and to purchase further lands.

Dorking.—The electric lighting question has been re-opened, and the U.D.C. is considering proposals for carrying out the work.

Durham.—The old cathedral city of Durham is shortly to have an electricity supply, the County of Durham Electrical Power Distribution Company, Limited, having established a generating station in the city under the management of Mr. J. S. Frain. It is confidently hoped that by Christmas the business will be well under way. At present the company have 50 prospective consumers on the books. Two Brush engines and dynamos have been fitted, the boilers are by Messrs. Babcock & Wilcox, and a set of Hart batteries has been installed. The mains have been laid by Messrs. Callender. Next year a scheme for tramways or light railways is to be commenced, the first part of which is a line to a colliery centre, named Brandon, about three miles to the west of the city.

Gillingham.—The U.D.C. (Chatham) have given notice of their intention to apply to the B. of T. for a prov. order to acquire certain lands, construct works, and to purchase the Gillingham and New Brompton portion of the Chatham, Rochester and District Electric Lighting Company, Limited. Gillingham is fast becoming a great dockyard and military centre, and already there is an application for the town to be incorporated. The Chatham and District Light Railways Company are now laying tramways all over the district leading to the dockyard and various military establishments.

Glasgow.—Owing to the sudden descent of a very dark cloud over the centre of the city between 12 and 1 o'clock on 21st inst., the electricity department experienced an increase in the demand from the equivalent of about 59,200 to 220,000 lamps of 8 C.P. in the space of about six minutes. This required the steaming up of four additional boilers at Port Dundas, which naturally could not be effected in time to avoid a drop in the pressure until steam was available. Special arrangements are in progress to meet such sudden demands by means of induced draught, which will enable the boilers under steam to double their output for the short time that such demands usually exist.

The Electricity Department propose to seek powers for letting or selling outright motors and other electrical apparatus, and to increase the capacity for storage.

Heckmondwike.—The electricity works have been completed, and the light was switched on on Monday night. The Council has decided to charge £12 per year for each arc lamp.

Hendon.—A public inquiry will be held on Saturday, December 7th, by the L.G.B. into the proposed loan of £36,400 by the D.C. for electric lighting purposes.

Italy.—The engineers, Giovanni Battista Costi and Felice Gallaoresi, of Milan, have presented an application for concession to the Prefecture of Côme for a catchment of water from the torrent of the Pioverna for the development of electric energy. The derivation will be 15 cubic metres per second, which, with a total fall of 123·52 metres, will give 2,470 H.P.

The engineer, Giovanni Gallini de Lovere (Bergame) has applied for the concession of a derivation of water from the course of the Oglio, comprising a catchment of 7 cubic metres of water per second, and capable with a fall of 8·76 metres of producing 817 H.P. to be devoted to the development of electric energy.

Messrs. Mutti Giovanni Maria and brother have applied for the concession of a derivation of water from the course of the Mella, comprising a catchment of 1,500 to 3,000 cubic metres per minute,

or a normal catchment of 2,000 cubic metres capable of producing 281 H.P., for the development of electricity for motive power and lighting.

Halifax.—In his annual report, Mr. Street, borough electrical engineer (now appointed at Southampton), says that as the deficits of former years have been repaid, future profits should be devoted to the depreciation account, which, he says, is most important. Mr. Street recommends that not less than 6 per cent. on capital outlay on mains and plant outside the station, 5 per cent. on machinery, &c., and 10 per cent. on accumulators, be allowed for depreciation. The amount thus realised when added to the sinking fund charges will allow an average of about 14 years for replacement of material on capital account. At these rates, up to March 31st this year, the provision for depreciation should have been £6,374, or £2,000 more than the net profit on the year's working, and £4,000 more than the sum in reality set aside for this purpose. The estimated capital expenditure up to March 31st next will probably be about £177,000, and on the basis mentioned above the depreciation charge should be about £8,400. The estimated gross profit for the year is £11,085, but from this must be taken £9,015 for interest and sinking fund, leaving as net profit a sum of £2,070. In such a contingency the Committee will have about £6,000 less than it should possess to meet the depreciation charges.

Kent.—An important Bill is being promoted in Parliament for the incorporation of the Kent Electric Power Company, which is being introduced for the purpose of establishing electric works and supplying electric energy to the various local authorities in Kent. It is stated that amongst the proposals of the company is a scheme to purchase the Chatham and Rochester electric lighting undertaking.

Kimberley.—The T.C. is discussing the advisability of installing accumulators in a town of the size of Kimberley, where coal is 50s. per ton and of an inferior quality; accumulators seem to be the only means of supplying energy in the daytime economically. White skilled labour, too, is quite four times as expensive as in this country.

The De Beers Company have placed the order for extra high-tension cables, for their new central station scheme, with the British Insulated Wire Company. Some 25 miles of three-core cables of this class will be required.

The firm of T. Reunit, of Kimberley, is supplying certain irrigation plant to Mr. Ritchie, of Modder River. This plant consists of a turbine driving a 500-volt direct-current generator, supplying current by means of overhead wires, to a 15-H.P. motor some 1,000 yds. distant; this motor drives a centrifugal pump, which supplies water to a large fruit and vegetable farm.

Kingstown.—The movement for the electric lighting of Kingstown Urban District has fallen through for the present.

London.—CAMBERWELL.—The Borough Council has decided to supply electricity within the borough and to purchase the existing rights of the London Electric Supply Corporation, Limited, for £25,000.

Louth.—The T.C. has decided to apply for a provisional order to supply electricity throughout the borough at an estimated cost of about £10,000.

Nelson.—The Corporation has agreed to supply the Burnley Corporation with current for tramways on the Nelson and Brierfield lengths at 2d. per unit. The reconstruction of the tramways has been started, and they will be running early in the New Year. The Corporation has received several applications for current for motive power for running looms, which will give a load for 56 hours per week.

Newark.—The E.L. Committee has reported on the negotiations with the Derby and Notts Electric Power Company; the draft heads of an agreement are under consideration. The matter is to be dealt with without further delay.

Newport.—The Corporation has accepted a tender for the supply of coal to the electricity works for the next 12 months at 7s. per ton.

Northumberland Coal Field.—We recently stated that it is purposed to put down a large power station in the centre of the Northumberland coalfield, to supply it with energy for lighting and motive power. The coalfield lies round Blyth, and although extending some miles both north and south it is, in the main, within easy reach of the town mentioned. Under the projected Bill power is sought to acquire lands at North Seaton and a short distance out of Blyth. The area which the company propose to supply is a very wide one, reaching from Heddon-on-the-Wall, which lies to the north-west of Newcastle-on-Tyne, to the east coast, and northward as far as Alnwick; the area stretches a considerable distance inland. The suggestion is meeting with great acceptance from the mining authorities in the district; several of the mines are now being worked at a very great distance from the pit mouth, a circumstance which is unavoidable in those pits where the seam runs under the sea, and the saving which might be made, were there some cheap means of locomotion, is apparent. The argument applies with scarcely less force in regard to pumping, haulage generally, and lighting. It may not be uninteresting to mention that Blyth had the honour of being the first place in the North of England to be lighted with electricity, about 12 or 13 years ago.

Rochdale.—Last week Colonel Luard, of the L.G.B., held an inquiry into the application of the Corporation to borrow £25,623, for the purposes of electric lighting.

ELECTRIC TRACTION NOTES.

Beckenham.—At the D.C. meeting on Monday official intimation was received that the B.E.T. Company intended to apply for powers to construct a tramway through Penge and Beckenham. The company also wrote offering to make a provision for the line to be leased to the Council on terms to be agreed upon. The matter was referred to the Works Committee for consideration.

Belfast.—The usual notice was made last week, that the introduction of a Bill for the electrical equipment of the Whitewell and Cavehill tramway in the ensuing session of Parliament was contemplated.

Blackburn.—The Borough Treasurer (Mr. G. H. Bailey) has issued a statement relative to the working of the tramways during the six months ended September 20th. The report shows a gross profit of £6,300 8s. 9d., but repayment of instalments of loans (£3,205 10s.) and interest (£4,036 16s. 1d.) converts this into a loss of £852 7s. 9d. This loss, however, was entirely in the first three months of the half year. The fares were increased on July 13th, and the result of that action is seen in a slight profit—something over £30—since that date. The expenditure amounted to £13,759 12s. 9d., which works out at about 8·65d. per car-mile, and the receipts were £20,060 1s. 6d., equalling 12·61d. per car-mile. The traffic receipts represented 12·48d. per car-mile, the details on the four Blackburn sections being: mileage, 291,020; passengers, 2,855,632; receipts £14,987 5s. 3d. On the Darwen section, which is worked in conjunction with the Corporation of that borough, the mileage was 90,606; passengers, 1,040,939; and receipts £4,793 16s. 6d. Some little "boycotting" was manifested against the trams when the increased tariff of fares came into operation, but this has almost disappeared, and a substantial profit is expected to result from the next half year's working.

Brighton.—On Tuesday, November 26th, the mayor, Mr. Alderman Stafford, inaugurated the new system of tramways in Brighton by opening for traffic the Lewes Road section. The company, which included the Town Council and mayors of all the neighbouring towns, assembled in the Pavilion at 11.30, when the mayoress had presented to her a souvenir of the occasion in the form of a silver driver's badge. They next took their seats in seven gaily-decorated cars, which were standing in readiness, and proceeded to the terminus of the line, the mayor himself driving the first car, assisted by Mr. T. B. Holliday, the engineer and manager. On the return journey the party stopped and inspected the new car-shed and offices, which the Corporation erected with their own staff. Accommodation is here provided for about 36 cars, together with the necessary repairing shops and a complete suite of offices and stores. The mayor then drove his car back to the Pavilion, when he declared the system open to the public. The barriers were now removed, and in an incredibly short space of time the cars were all full. A three-minute service was maintained throughout the afternoon and evening with 12 cars, and the total number of passengers carried the first day was a little over 19,000. The system comprises about 12 miles of line, mostly double track, and is laid out on the overhead trolley system. Between the rails the road is paved with red gum blocks throughout. At present there are 30 cars, which were supplied by the Westinghouse Company, Messrs. Milnes being the sub-contractors for the car bodies. The whole of the work of laying the rails has been carried out by Messrs. Macartney, McElroy and Co., while Messrs. R. W. Blackwell & Co. erected the overhead equipment, and the St. Helens Cable Company laid the underground cables. It is hoped to open the remaining routes within a fortnight.

Dudley and Blackheath.—An eighth line of tramway leading to and from Dudley is to be constructed by the B.E.T. Co. From the Bush Inn, at Dudley, a new line is to run round by King Street up to Hall Street, Dixon's Green, along the new Rowley Road to High Street, Blackheath. Besides this, another line will be carried from Old Hill to Blackheath, and thence in time to Oldbury and Birmingham. The length of the former line will be nearly four miles. The Dudley Town Council and the Rowley Urban District Council are co-operating in the business, which is to be carried forward to completion with as little delay as possible.

Electric Traction on American Railways.—The *Scientific American* says that President James J. Hill, of the Great Northern Railway, is preparing to operate a 66-mile section of that railroad through the Cascade Mountains with electricity instead of steam. If the project proves successful it is proposed to operate an entire division from tide water at Everett to Wenatchee on the Columbia river, a distance of 141 miles, with electric motors. This accomplishment, railroad men believe, will be but the beginning of the equipment of the entire main line with electricity. The plan of substituting electricity for steam has been forced upon Mr. Hill by his long tunnel and peculiar conditions. His present plans as announced, contemplate the application of electricity to that portion of the road extending from Leavenworth on the east side of the Cascades to Skykomish on the west side, 66 miles. It is understood that if the electric motors prove as successful as anticipated, the electric system will be further extended so as to include the mountain division, from Everett on Puget Sound to Wenatchee, 141 miles. This would be the beginning of an electrification which might eventually include the entire mileage of the system. The section of the road chosen for the first application of the experiment is the most difficult and expensive portion of the road to operate on the entire system. It runs through the wild and rugged Cascade where the grades are very heavy, and where every winter there are numerous slides of earth and rock which come down the

steep mountain sides to cover the track and endanger the operation of trains. One of the most important causes of the Great Northern's desire to secure cheaper motive power is the fact that its tributary coal supply is very limited. The details of President Hill's plan are now being worked out, and it is understood that active work toward the installation of the electric power will be commenced next spring.

Glasgow.—A linesman (E. Connelly) claims £500 or £300 from Messrs. Macartney, M'Elroy & Co., under the Employers' Liability Act, as damages for personal injuries sustained while in their employment. He had to climb one of the tramway poles to enable him to fasten a wire, and in order to save himself from falling, he caught hold of a span wire; as it was "alive" at the time, his hand was badly burned. The defenders deny liability and plead contributory negligence.

We read that an offer by the British Electric Traction Company, Limited, for the plant of the Springburn Depôt has been remitted to Councillors Hugh Alexander and Paton and the general manager, with powers.

Great Orme's Head.—The scheme of the proposed electric tramway around the Great Orme's Head, projected by the Llandudno Urban Council at a cost of £30,000 to the ratepayers, has aroused strong opposition.

Greece.—It has been decided to transform the well-known Pirœus and Athens railway into an electric line. A competition is to be opened for the work of transforming the line, which is at present worked by steam. It is proposed to run trains every 15 or 30 minutes, according to the season. In addition to regular services of goods trains, numerous "mixed" trains are to be run. The line has a regular gradient of 1·4 per cent. The overhead system is to be employed.

Halifax.—Since the heavy rains, says our local correspondent, the water question has not been so acute at the electricity works. The scarcity of water for some time past has been such that on several occasions the Tramways Committee seriously considered the advisability of stopping the service, as a saving of 30,000 gallons of water would have resulted from such a step. As it was the full service was kept on, and the only inconvenience resulting was on one day when the service of cars could not be started till 8 a.m., there being no available water to put in the boilers. For the last 10 weeks the station has been working practically as a non-condensing one, the Hebble Brook, which supplied the condensing water, being practically dry. In his report on the six months' working—March to September—the borough electrical engineer (Mr. H. F. Street) states that the net profit amounts to £1,074, the gross profit being about £3,800. The out-put for the six months was 1,206,544 units, and the total cost of production, exclusive of interest, sinking fund and depreciation, is 1·3d. per unit, which the engineer reports as satisfactory, seeing that the period covers the summer quarters. A satisfactory increase in the number of motors is noted since the continuous current has been available all over the town in place of the single-phase alternating. But for the same reason a large decrease is shown in the units metered for public lighting. Attention is also drawn in the report to the very noticeable "peak" in the tramway load during the hours of 5 and 10 p.m., this being the time of heaviest call on the cars. This peak unfortunately corresponds with the heaviest lighting load.

Hounslow to Slough.—The Metropolitan District Electric Traction Company have given notice of their intention to apply to the Light Railway Commissioners for an order authorising the construction of electric tramways from Hounslow, along the Great Bath Road, to Slough, with a branch line to Datchet-on-Thames.

Ilkeston.—The preparation of roadway to receive the electric tram rails has commenced.

Lancaster.—The electrical engineer (Mr. Tester) has reported to the committee as to the new plant necessary in consequence of the tramways installation. It is probable that the negotiations for the purchase by the Corporation of the undertaking of the Lancaster and District Tramways (a four-mile line to Morecambe) will be reopened. The directors have agreed to meet the Corporation again, and it is hoped that an amicable arrangement will be arrived at; otherwise it will be 10 years before Lancaster and Morecambe are connected by electrical cars.

Llandudno.—The D.C. has discussed a report by the E.L. Committee *re* a draft agreement submitted by the Llandudno, Colwyn Bay and Rhyl Traction Company, Limited. On comparing the draft with the agreement previously made, the committee thought that clauses in the draft amended conditions laid down in the original agreement. The Council resolved that a consolidated agreement, which had previously been asked for, should be required from the Traction Company. The minimum amount of electricity to be supplied by the Council to the company has been reduced from 300,000 to 200,000 units per annum.

London.—At the annual meeting of the Lea Bridge, Leyton, and Walthamstow Tramways Company on 26th inst., the chairman said that some had spoken very strongly in favour of using electric traction on the company's lines. Although the directors would be very pleased to see this done, believing it would bring the property up to date, it was impossible, under the existing conditions, to consider the matter, as certain portions of the company's system would in August next come under the operation of Section 43 of the Tramways Act, and the local authorities would be competent to purchase those portions if they should be so advised. It was certain that the "electrification" of the line could only be carried out by the directors if they were granted a long lease. Many of the local corporations around the property were building tramways, or talking about doing so. It would not seem unlikely, therefore, that the directors might be asked to enter into negotiations for selling the company's lines.

Manchester.—It is reported that steps are being taken to promote an underground "tube" railway scheme for Manchester with a capital of £1,500,000.

Monte Video.—The Uruguayan Chamber is about to accord to a native company a concession of electric tramways, connecting the capital with various districts in the environs. The system will be one of 30 kilometres with turn-outs at each 500 metre mark. The overhead system will be used.

Paignton.—The U.D.C. has decided to adopt the Kingsland surface contact system in connection with the proposed tramway from Paignton to Torquay.

Paris.—M. Baudin, Minister of Public Works, has deposited on the table of the Chamber of Deputies a project having for its object the declaration of public utility of the establishment of a metropolitan railway from the Place du Palais Royal to the Place du Danube, Paris.

Potteries.—Two electric cars collided between Hanley and Fenton on 25th inst., and five persons were injured. One of the cars, it seems, did not respond to the brakes when on a steep gradient, the rails being slippery at the time.

Richmond.—The L.U.T. plans for extensions affecting this district include the electrification of the Kew Road line, and a new line to Hammersmith *viâ* Barnes and Mortlake. The route of the latter has been chosen with a view to meet local opposition to previous schemes.

Rome and Naples.—It is proposed in Italy to establish shortly a railway between the capital and Naples. The direct line will probably be worked by electricity with three-phase currents without any stoppages. The engineers responsible for the project in question are Messrs. Guerro and Ferrara. There is a lively discussion going on between the journals of Northern and those of Southern Italy. The latter are in favour of the railway, which was voted for by the Government several years ago; the others say that the railway is perfectly useless, and that it would be better to expend in agriculture the 140 millions required, according to them, for the establishment of the said railway. On October 21st last, a meeting was held at the Commercial and Industrial Association, and a very interesting discussion took place with regard to the projected railway. The starting stations at Naples and at Rome will be situated in the centre of the towns, which will render the railway easy of access. The service will consist of light, frequent and very fast trains with a speed of from 75 to 90 km. per hour. The importance of the new railway may be judged by the fact that recently a little torrent near Legni rendered the existing line impassable for a distance of 29 km., breaking down two bridges. It took a month to get the line in working order again, and during that time either a two hours' journey by road had to be performed, or else a detour made. It may be conceived what a great inconvenience this would be from a military point of view in times of war. Moreover, the present railway is 243 km. long, whereas the proposed railway would be only 230, and would pass almost entirely through plains. At present it takes five hours to go from Rome to Naples by ordinary trains, and three hours by express. By the new Guerro-Ferrara line, the journey could be performed in less than three hours. The Minister of Public Works favours the project, and the line has already been voted for by the Chambers. The Società Mediterranea, which is working the present railway from Rome to Naples, opposes the new one, and says that it would cost more than 120 millions. The truth is, according to several Italian technical men, that the new railway would only cost about 40 millions, *i.e.*, about 125,000 fr. per km. As regards the yield of the present line, the official figures give 38,000 fr. per km. The new railway would not be worked at the cost of the Government, which would only be responsible for a grant of 6,000 fr. per km., *i.e.*, 1,380,000 fr. per annum, and it must not be forgotten that the Government claims a share in the profits of these complementary railways, which would greatly reduce, if not cover, the above-mentioned figures. We possess very few data from an electrical point of view, but the fact that a committee of competent men has repaired to Berlin to study the high speed system which is being tried by Messrs. Siemens & Halske and the Allgemeine Electricitäts Gesellschaft at a speed of 140 km. an hour leads us to believe that three-phase currents will be used. Indeed, there is practically no alternative in a case of this kind.

Sandwich.—The T. C. has appointed a Committee to confer with the Deal T.C. *re* a light railway to run through the sand hills between Sandwich, Deal and Walmer.

Sutton.—From the printed minutes of the U.D.C. it appears that electrical tramway matters have been discussed at length *in camera*; it was urged that the Council should apply forthwith for a provisional order, but it was decided that the step would be premature. Mr. Hulme, of the British Electric Traction

Company, also attended the meeting to explain his company's proposals, and it was decided to inspect the suggested route. It was suggested to use the trolley standards for electric lamps.

Wakefield.—The Wakefield and District Light Railway Company have given notice to the various local authorities interested of their intention to apply to the Light Railway Commissioners for an order empowering them to extend the Wakefield and District Light Railways (authorised) to Dewsbury on the one hand, and to Normanton on the other. All the lines in the West Riding of Yorkshire are to be worked electrically, and of 4 ft. 8½ in. gauge.

Wimbledon.—The L.U.T. revised plans for tramway extensions affecting the locality comprise a line running from the Norbiton Hotel, New Malden, to Wimbledon Hill *vid* West Barns Lane, Coombe Lane, Worple Road, Francis Grove and St. George's Road; the route will hardly affect North Wimbledon, where opposition to the introduction of any tramways is very well organised. Thence the line will cross the railway and reach Merton High Street *vid* Broadway, ultimately connecting with the L.C.C. tramways at the Tooting boundary. A branch of this latter line will be taken along Haydon's Road and Plough Lane to the L.C.C. boundary at Garrett. Northward an extension is proposed up Wimbledon Hill, High Street and Park Side, but this portion, as already reported, is unanimously opposed by the resident ratepayers. Sundry street widenings are provided for, but hardly sufficient to meet recent criticisms. The route also involves two railway crossings.

Local approbation is accorded to a proposal to construct a tube railway from Hartfield Road, Wimbledon, connecting with the metropolis *vid* Wandsworth, Battersea, Kennington, Southwark, to a terminus at Cannon Street.

TELEGRAPH AND TELEPHONE NOTES.

Improvement in Wireless Telegraphy.—An improvement has just been effected in telegraphy without conductors, with regard to the method of decohering the sensitive tube or coherer. It is usual to give a shock to the tube by means of the little hammer of a kind of electric bell worked at the same time as the receiver. This has the disadvantage of affecting the tube and its contents after a little while. The improvement above mentioned enables us to arrive at the same result by quite a different method; the magnetic relay acts upon and turns several parallel tubes, which constitute the coherer. After the emission of the wave, the tubes revolve, and the particles separate under their own weight, and continually tend to resume their normal position. The inventor of the arrangement in question—which recalls to a certain extent the one proposed by Messrs. Lodge and Muirhead in their patent of July 16th, 1898—is Mr. J. Cross, engineer to the American company recently formed for telegraphy without conductors. It is reported that wireless telegraphy stations fitted up on the Cross system have been installed at the Islands of Hawaii, and are working between Waialee and Honolulu.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Para-Maranham	March 1, 1900 ..	..
Landlines :—		
"*Via* Hankin" on Persian territory	Feb. 24, 1900 ..	..
Pekin-Kalgan	June 14, 1900 ..	..
Maimatchin-Kalgan	June 30, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..
„ towns of Venezuela ..	Oct. 31, 1900 ..	..

The National Telephone Company, Limited, and the Post Office.—The following communication has been received from the National Telephone Company :—"The conclusion of the agreement between the Post Office and the company relating to the London telephone service, based on the principle of co-operation in the public interest, involves a new departure for the company. The negotiations which have ended in this desirable result were extremely difficult and very protracted, and were carried on with the Postmaster-General by Mr. Forbes, on behalf of the company, with the valuable aid of Mr. Gaine, the able general manager. This important business having now been brought to a satisfactory conclusion, Mr. Forbes, for domestic and other reasons, desiring to be relieved from the heavy care and anxiety of the position he has so long held as president of the company, determined to resign that position, and Sir Henry Fowler, the vice-president, has been elected to fill it, Mr. George Franklin becoming vice-president. This change involves some re-organisation of the board, and upon consideration Mr. Forbes has decided that he would prefer to resign his seat as a director, and in accordance with a very kind and flattering invitation of the board, place his experience and services at their disposal in the capacity of general adviser."

We understand that the agreement which has been concluded between the Postmaster-General and the National Telephone Company, besides fixing rates to be charged equally by the Postmaster-General and the company, provides for the purchase of the company's plant in London on the expiration of the license in 1911; for full and free inter-communication between the two systems, and for the company's subscribers having all facilities which may be afforded to the Post Office subscribers and on the same terms. It also contains provisions under which the company will be able to obtain the use of underground wires in the London area upon reasonable terms. The real and underlying principle of the agreement seems to be, that for the future there is to be mutual co-operation between the Post Office and the company in the development of the telephone system in London so as to make it as convenient as possible for the subscribers to both systems, and to confine the competition between the Post Office and the company to the efficiency of the service and the convenience of the public. In other words, it will be "competition" as regards quality of service, and "co-operation" as regards working arrangements.

Wireless Telegraphy for Italian Semaphores.—The Administration of the Italian Navy, in consideration of the successful results obtained, has decided to extend the use of wireless telegraphy on the Marconi system to all the Italian semaphores, so as to put them in a position to communicate with vessels out at sea. It is also hoped that several semaphores will be enabled eventually to communicate with one another. The Italian War Office will now also adopt wireless telegraphy. Several trials have already been made with very satisfactory results, and various instruments have been ordered from the electricity works at Spezzia.

Wireless Telegraphy in Spain.—The Transatlantic Company have just established telegraphic communication between Cadiz and the works at Malagorda, a distance of 5 km., with wireless telegraphy apparatus, on the Rochefort system. The Spanish journal *La Energia Eletrica* (of Madrid) reporting upon the matter, observes that this is the first installation established in Spain with the new telegraphy and of a permanent nature.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bermondsey.—December 3rd. Arc lamp carbons, india-rubber cables and jointing materials, &c., for the electricity and destructor works. See "Official Notices" November 15th.

Birkenhead.—The Corporation Tramways Committee invite tenders for a supply of the following stores for the 12 months ending December 31st, 1902 :—Poplar wood blocks; cast-iron brake blocks and other castings; motor grease; river sand; cleaning cloths; sponge cloths and brushes.

Brussels.—December 11th. An adjudication will take place on this date at the Bourse of Commerce (salle de l'Union Syndicate), Brussels, for supply of sundry requisites for the use of the telegraph service in 25 lots, viz.—1st lot, galvanised iron wire (caution 1,180 fr.); 2nd lot, cables (1,370 fr.); 3rd lot, copper wire (210 fr.); 4th lot, copper wire insulated (5,020 fr.); 5th lot, pliable wire (50 fr.); 6th lot, irons and rods (290 fr.); 7th to 12th lots, ironwork (2,170 fr., 1,700 fr., 2,030 fr., 2,030 fr., 370 fr. and 280 fr.); 13th lot, galvanised steel receivers (2,510 fr.); 14th to 19th lots, isolators (14th and 15th lots, 620 fr. each, 16th lot, 400 fr., 17th and 18th lot, 1,520 fr. each, 19th lot, 130 fr.); 20th to 24th lot, telephonic and telegraphic apparatus (20th lot, 720 fr., 21st lot, 100 fr., 22nd lot, 1,080 fr., 23rd lot, 360 fr., 24th lot, 300 fr.); 25th lot, nuts, supports, screws, &c. (190 fr.).

Burnley.—December 12th. Electric lighting plant, battery, switchboard, wiring and mains, steam pumps, piping, &c., for the electric lighting of the Union Workhouse. See "Official Notices" November 22nd.

Cleckheaton. — Lancashire boilers, economiser, condenser, pumps, pipes, and water tank for the electricity works. See "Official Notices" November 15th.

Dewsbury.—December 2nd. Two 100-KW. dynamos for the electricity works. See "Official Notices" November 22nd.

East Ham.—December 9th. Wiring the new municipal buildings. See "Official Notices" to-day.

France.—December 16th. Estimates will be opened at the Hotel de Ville, Surisnes, France, on 16th prox., for the supply of three electric units and pumps, for the purpose of raising water in the departmental drainage station; and at the Hotel de Ville, Courbevoie, France, on same date, supply of two electric groups and pumps for same purpose. Information in each case from the municipality.

Huddersfield.—December 9th. Engine, 750-KW. generator, boosters, boiler, piping, stoker and conveyer, economiser, switchboard, line equipment, cables and conduits, car bodies, trucks and equipments for the Corporation traction scheme. See "Official Notices" November 22nd.

Kirkcaldy.—November 30th. Rolling stock and electrical equipments for the Corporation. See "Official Notices" November 15th.

London.—December 12th. Electric wiring, &c., of Bishopsgate, Brompton and Manchester Square fire brigade stations for the L.C.C. See "Official Notices" November 22nd.

London.—December 19th. Electric fire alarm system for the N.W. Fever Hospital, Hampstead, for the Metropolitan Asylums Board. See "Official Notices" to-day.

(*Continued on page* 893.)

MACHINE TOOLS AT THE GLASGOW EXHIBITION.

(In Special Reference to the Requirements of Dynamo and Motor Manufacturers.)

By FRED. BATHURST, A.M.I.E.E.

(*Continued from page* 847.)

Shaft Finishing Lathes.

The well-known machine tool firm of Selig, Sonnenthal and Co., with head offices in Queen Victoria Street, E.C., had an extensive general engineering exhibit, both in the Machinery Hall and in the Pavilion in the North Gardens. This firm acts as agent to several of the best tool makers in America.

To touch upon one or two main points, reference should be made to an improved type of lathe, known as the "Sundale" special sliding lathe, which has been specially designed for turning up light shafts, spindles, studs, &c. These lathes cost but slightly more than the ordinary make of lathe, and possess advantages which should become known to English dynamo manufacturers. The 6-in. (height of centres) lathe will turn shafts up to 4 ft. 6 in. long, and 2 in. diameter.

The lathe bed is of specially strong design, and is provided with **V** grooves in which the saddle and tail-stock can slide. This **V** shaped bed, although apparently a minor improvement, really adds much stability and greater accuracy to the lathe, and would seem likely to be adopted by lathe makers as a standard. With this particular lathe the makers guarantee accuracy of work within a limit of $\frac{1}{2000}$th of an inch, and the work it can turn out would ordinarily be done on a screw-cutting lathe costing, perhaps, £52, whereas this special lathe can be bought for £31 10s.

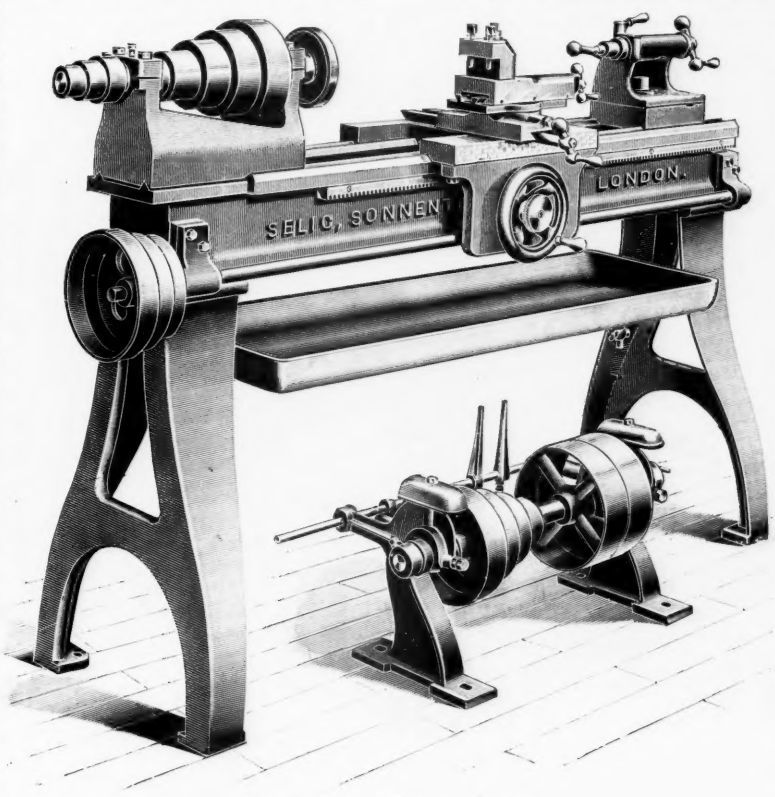


Fig. 6.—Shaft Finishing Lathe.

The illustration fig. 6 will show that an automatic feed is provided by arranging a shaft below the bedplate, on the same lines as a shaft has to be provided on screw-cutting lathes.

The slide rest has the ordinary compound motion, but by a simple clutch arrangement its saddle can be secured to the feed shaft, so that the cutting tool can travel automatically from one end of the bed to the other. In trimming up shafts, therefore, the cutting of the tool being once adjusted, the lathe can be left to do its work automatically.

The automatic feed gear can be instantly thrown in or out of gear by a small screw knob arranged on the regular hand-wheel. Taper work is provided for by arranging that the sliding tool rest can be set at an angle at the same time that the tail-stock is set "off centre." For this purpose the tail-stock is built in parts, the lower part remaining fixed on the **V** bedplate, whilst the upper, carrying the centring arbour, is adjustable thereon.

An interesting point of detail, showing that the design has been carefully evolved, is noticeable in the provision of a small oil reservoir on the tail-stock casting, together with an oiling pin. This saves the waste of oil which occurs when the machinist endeavours to oil his bearing centres from an oil can, or leaves his work in order to look round the shop for the oil can, which, he finds, someone else has taken away to use.

Another novelty shown by Messrs. Selig, Sonnenthal & Co. is a patent screw-cutting and feeding attachment, which is applicable to any screw-cutting lathe, and which is really a compact and complete box of gearing designed to take the place of the loose change wheels. All users of screw-cutting lathes know the delay caused by having to change gears when a different screw-thread has to be made. The machinist usually spends considerable time in looking out the necessary gear wheels, and when they are fitted, may not feel quite confident that he has taken the correct ones.

From the fact also that the spare gears form a separate part of the machine equipment, they are not always conveniently to hand, and may be mislaid or broken. The idea of this new patent attachment is to provide a simple gear-box which is fixed on the lathe complete, and enables any change of gear necessary to be quickly effected without loss of time, and with certainty, even by an unskilled workman.

The attachment, as shown by the illustration (fig. 7), is bolted either to the slotted quadrant or the stud plate of any screw-cutting lathe, taking the place of the intermediate gear between the spindle or stud and the gear on the lead screw-shaft. The operation of changing gears is simply to refer to a table fixed on the gear-box, and insert the steel spindle of the stem marked A into one or other of the marked holes shown on the end plate, the gear-box being rotated until the number of the hole, as shown by the table, comes opposite the fixed pointer marked "right." A knob is then turned which engages the gears, and the operation is complete. Right or left-hand threads can be provided for by another simple movement of a small lever. This gear box is immediately adjustable to any standard screw-cutting lathe, and is made in four sizes for lathes from 4 or 6 in. up to those having 10 to 15 in. centres. One to six changes can be made by the standard attachment which cover all ordinary requirements of screw-cutting. The attachment can be made to cut any special threads that may be required.

Another exhibit (see fig. 8) of use and interest to electrical manufacturers is the multi-speed portable "Stow" electric motor in combination with a flexible shaft and drilling machine. This machine, in its original form, is already well known, and is largely used in machine shops. The difficulty experienced in many non-electrical shops, however, has been that the unskilled operator has had to control the speed of the motor by means of some form of rheostat, and electrical difficulties have consequently been introduced.

In the present improved form it has been sought to eliminate all electrical devices that were likely to confound or frighten the workman. The operating switch is now

worked by an ordinary lever arranged at the side of the machine, the electrical parts being boxed up, so that no sparks are to be seen or "shocks" to be felt. The speed of the motor is regulated by a handwheel arranged on the top

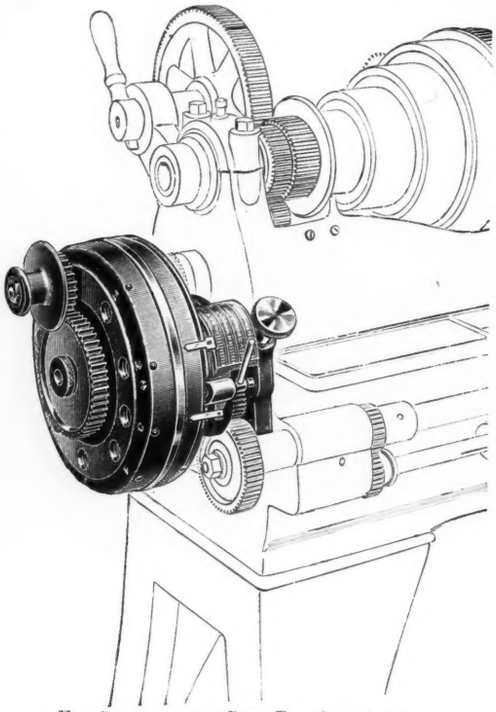


Fig. 7.—Complete Gear-Box Attachment.

of the enclosed field-casting and operates by changing the intensity of the field magnetism. A speed variation of over 50 per cent., with any intermediate speed, can now be secured, instead of the five or six changes formerly possible when using an ordinary rheostat regulator. The possibility of obtaining any intermediate speed between the extreme speed limits allows adjustment to the utmost nicety for the various shop operations of drilling, tapping, reaming—as well as grinding or polishing—in reference to the work to be done, or to the skill of the individual workman. The illustration shows that the motor, besides being iron-clad, is practically dustproof and waterproof.

The handwheel operates this inner core or plunger in a radial direction to the centre of the armature, and it is so designed that a slight alteration of its position within the magnetised shell produces a very considerable difference in the reluctance of the magnetic circuit, of which the plunger forms a part. The speed of the motor becomes a maximum when the reluctance of the magnetic circuit is increased to its maximum as the plunger is withdrawn. The design of the motor is

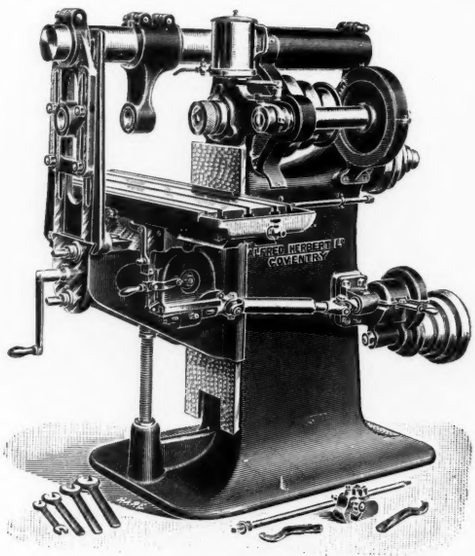


Fig. 10.—Horizontal Milling Machine.

such that a sufficiently intense magnetic field is secured at all times, so as to ensure sparkless running of the armature, the principle being to maintain a practically constant amount of magnetism *at the pole tips* irrespective of the total magnetism passing through the pole-piece. This sparkless commutation can be secured under all conditions of total field strength.

Drilling Machines.

Several exhibitors showed drilling presses and standard drills in their exhibits, but to take a standard type which embodies all the features which experience has proved valuable, we may refer to the drill standard (fig. 9) exhibited by Alfred Herbert, Limited, of Coventry, who is

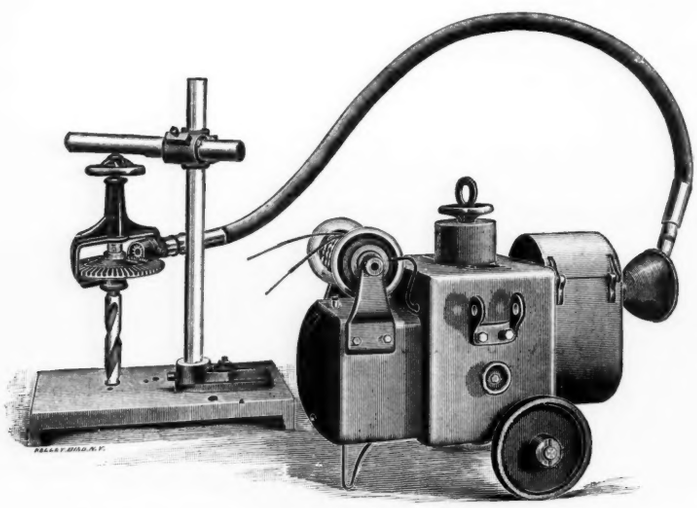


Fig. 8:—Multispeed Portable Motor and Drilling Attachment.

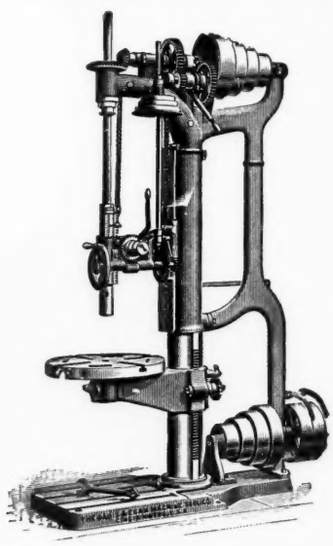


Fig. 9.—Drilling Standard.

The adjustable field pole-piece is of special construction, arranged as a plunger within a solid core of high permeability (around which the magnetising coil is wound), and has a large cross-section relatively to the enclosing shell.

the English agent for the drilling machines made by the American Tool Works Company, of Cincinnati, Ohio, U.S.A.

It will be noticed that the frame of the machine is of very rigid construction, the back member being taken right

down to the foot plate so as to prevent the column vibrating or being forced back by the strain of heavy drilling. This construction adds greatly to the stability of the machine. A lever feed is provided for light drilling, and a worm feed for heavier drilling, together with quick return motion. The sliding turning head is balanced, and can be quickly adjusted to suit work of varying height. The back-gear can be thrown in or out of gear by a lever without unscrewing any nuts. The drilling table used for ordinary work is arranged to swing on one side so as to admit large articles to be clamped direct to the base plate.

The automatic feeding gear can be instantly thrown in or out and without loss of motion, an automatic stop being provided so that it can be thrown off at any desired point. This detail is a valuable addition to drilling standards, as it enables any quantity of holes to be drilled to exact depth, and in the case of repetition work one operator can operate several machines at one time. The sleeve of the drilling shaft is graduated so that the depth of any hole can be accurately seen at a glance.

Whilst on the subject of drilling presses, it is interesting to note the great progress being made in what, to a superficial observer, may appear an unimportant point. The shop superintendent is finding out that it is not only necessary to secure machines of up-to-date design which are able to give increased output, but that it is no good providing these machines without full attention to detail improvements that go to assist them.

Shops, in which large amounts of repetition drilling, reaming, and tapping have to be done, are no longer satisfied to buy grinding or sharpening machines for keeping their drills, &c., in good condition, but must further assist the output by providing special chucks or collets to enable the drill or tap to be quickly changed. There are now on the market several such devices, so that the drill or tap can be inserted or replaced without stopping the drill spindle.

Further refinement in respect to screwing is a device which provides that the screwing tap cannot be overturned; usually a spring device is provided, which, whilst giving the necessary power to drive the tap so as to cut the screw thread, is free to yield before breaking the tap. Messrs. Burton, Griffiths & Co., Messrs. Selig, Sonnenthal & Co., and Messrs. Smith & Coventry, of Salford, Manchester, each exhibit up-to-date and useful devices in these lines.

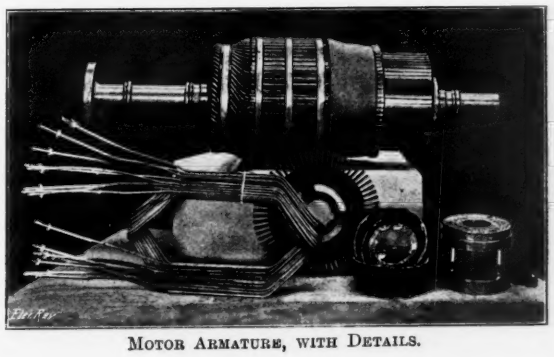
The recent addition of special forms of twist drills and screwing taps, shows clearly the keenness with which every detail connected with increased output is now being attended to by all classes of machine tool maker. These new forms need not be referred to in detail, as they have hardly yet received general endorsement. Messrs. Alfred Herbert, Limited, besides showing a full line of automatic screw machines, exhibited a horizontal milling machine (see fig. 10), which is of new design, and one of the most complete and efficient machines of its capacity in existence. The overhanging arm is made of steel, and well supported by a rigid arm-brace of improved design. An improved feed motion of unusually great range has ample driving power to feed up to the full capacity of the machine. A change of 2 to 1 furnishes an intermediate change from a rough to a finishing cut. The feed mechanism can be driven direct, either from a spindle, or from a countershaft, which enables feeds from 0·1 in. up to 12 in. per minute to be obtained.

(To be continued.)

Adamson "Goliath" Travelling Crane.

GOLIATH TRAVELLING CRANE.

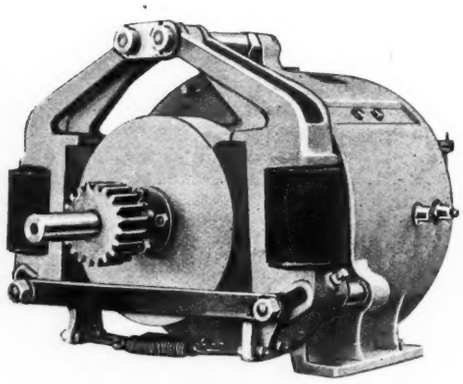
The crane which we illustrate herewith was recently built by Messrs. Joseph Adamson & Co., of Hyde, for the Horsehay Company. The latter provided the steel frame-



Motor Armature, with Details.

work. The crane is designed to lift 10 tons, with a span of 40 ft. The end carriages are fitted with Messrs. Adamson's improved self-lubricating axle boxes, with rollers

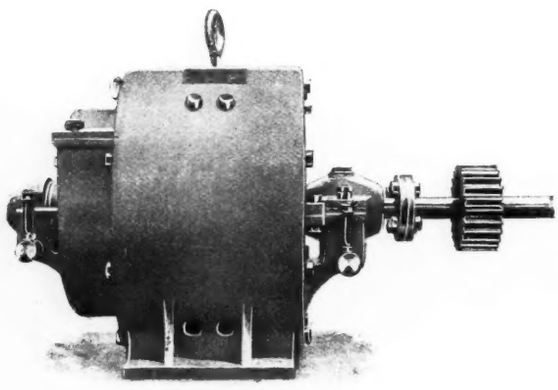
floating in oil. The travelling wheels of the carriages have rolled steel double flanged tires, and the runner wheels of the crab are of cast-steel. The bevil wheels transmitting power to the travelling wheels are of cast-steel, made from



Hoisting Motor with Magnetic Brake.

cast-iron machine-cut patterns; all the rest of the gearing is cut out from the solid.

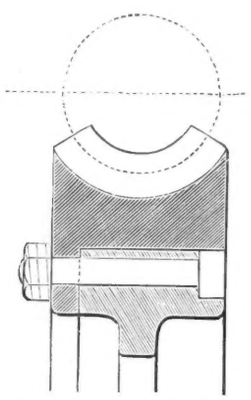
The motors are all of Messrs. Adamson's own construction, and are of the multipolar enclosed type, specially made for



Motor for Cross Traversing.

cranes. They are built with the bearings quite outside the casing, in order to prevent any chance of oil getting inside the case.

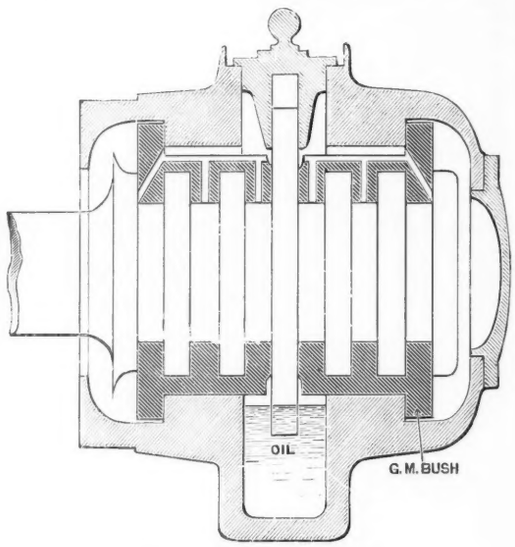
The armatures are of the slotted-drum barrel type, with



Cross-Section of Rim of Worm-Wheel.

former-wound coils. The commutators are constructed of drop-forged copper sections, insulated throughout with mica, and are made specially large in order to keep down the temperature. Fixed carbon brushes are used, the field-magnets being designed to give sparkless commutation under all conditions of load. The field coils are wound on formers and thoroughly insulated before being put in position on the cores.

One of our photographs shows the armature of one of



Detail of Thrust Bearing.

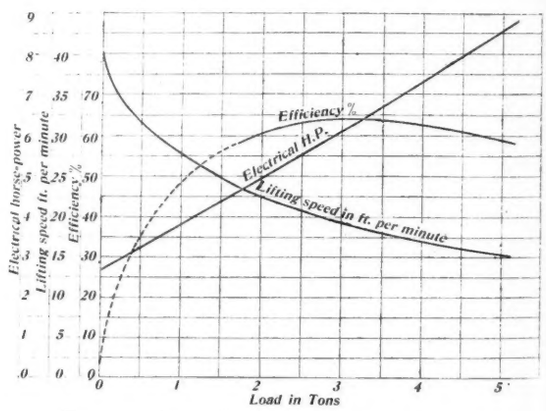
these machines complete with the spindle and commutator, as well as a formed coil, armature disc, details of commutator, &c. Another view shows the motor for the hoisting motion, complete with pinion end and automatic magnetic brake.

The hoisting motion was specified to be at the rate of 14 ft. per min. with full load; a load of two tons was to be lifted at not less than 25 ft. per min. without change of gear. This motion is driven by a 24-B.H.P. motor, running at 1,000 revolutions per minute. The first reduction of the hoisting motion is by machine-cut worm gearing with steel worm, the worm wheel having a manganese bronze rim. Our figures show this, as well as the thrust bearing, which is of the marine type, with thrust collars, and with the addition of arrangements for continuous automatic lubrication; the larger centre thrust collar picks up the oil from the reservoir and delivers it to all the other collars.

The cross-traversing motion was specified to be at the rate of 60 ft. per minute, and is driven through spur gearing from a 3-B.H.P. motor running at 420 revolutions per minute.

The load is carried by four plies of $2\frac{1}{4}$ in. circumference steel wire rope passing on to a barrel, which is grooved right and left hand to give a true vertical lift. The hook is fitted with ball bearings.

The motions are controlled by independent reversing



Efficiency Curves of 5-ton Workshop Cranes.

switches, of Messrs. Adamson's own make, placed in the cage shown on the photograph. The insulated cables are of the lead-covered type, to prevent oil from damaging the insulation.

The first motion pinions and worms are cut out of the solid, thus avoiding the use of keys to secure them to their respective spindles. The first motion gear of each train is enclosed in a cast-iron case, to exclude the dust and retain the lubricant.

The estimated total weight of the crane is 26 tons.

The actual results of the tests are given below, in Table I.

TABLE I.

Motion.	Load.	Volts.	Amps.	Speed.	Efficiency.
Hoisting	10 tons 7 cwt.	210	84	8 ft. in 32 secs.	43 %
"	" "	226	87	5 ft. " 18½ "	43 %
"	Light	225	25	9 ft. " 14 "	—
"	"	225	25	9 ft. " 14 "	—
Cross traverse	10 tons 7 cwt	219	22	10 ft. " 8 "	—
" "	" "	218	23	12 ft. " 11 "	—
" "	" "	217	23	12 ft. " 11 "	—
" "	" "	217	22	12 ft. " 11 "	—
" "	Light	219	18	100 ft. " 60 "	—
" "	"	217	18	100 ft. " 60 "	—
Longitudinal travelling	10 tons	210	30	100 ft. " 22 "	—
"	Light	210	20	100 ft. " 20 "	—

Particulars of tests of one of two cranes recently completed for Messrs. Yarrow by Messrs. Adamson, may also be of interest, as they were most carefully carried out by Messrs. Yarrow's representatives at their own works. Both the cranes were constructed to deal with loads up to 5 tons, the spans being respectively 47 ft. 6 in. and 34 ft. 1 in.

The other particulars are given in the accompanying Table II., and are graphically shown in the diagram on

TABLE II.—MEAN RESULTS OF TESTS.

5-ton Adamson Crane in Light Machine Shop. Tested August 26th, 1901. Deflection of Cross Girder of Crane = ⅛ in. with 5-ton load.

Load.	Ft. per min.	Amps.	Volts at crane.	E.H.P.	B.H.P.	Efficiency per cent.	Amps. at starting.
5 tons	15·312	33	195	8·64	5·09	59	55
4 tons	17·06	28	195	7·33	4·64	63·2	40
3 tons	18·832	23	195	6·01	3·84	64	40
2 tons	22·25	19	195	4·96	3·02	61	38
No load	39·2	10·2	195	2·66	—	0	38

Hoisting.—*Guaranteed* to lift 5 tons at 15 ft. per min. with 210 volts at crane.

Longitudinal Traverse.—Average = 162 ft. per min. with 25 amps. and 195 volts at motor. Starting current 50 to 60 amps. *Guarantee* 150 ft. per min. with 210 volts. Average speed light, 208 ft. per min., with 20 amps. at 210 volts. Starting current 50—60 amps.

Cross Traverse.—Average = 78 ft. per min., with 8·8 amps. and 195 volts at motor. Starting current 14 to 17 amps. *Guarantee* 60 ft. per min., with 210 volts. Average speed light, 90 ft. per min., with 6 amps. at 205 volts. Starting current 17 amps.

p. 892. The tests on one crane only are given, because the two sets are practically identical.

As we have previously explained in our pages, Messrs. Adamson & Co. have special facilities for testing their cranes under ordinary working conditions before delivery, thus enabling them to ensure that satisfactory results shall be obtained when tests are carried out again by their customers after delivery.

CONTRACTS OPEN.

(*Continued from page* 888.)

Maidenhead.—December 13th. Steam piping, transformers, motor-generators, battery, switchboard, arc lamps, cable work, and crane for electric lighting works. See "Official Notices" November 22nd.

Manchester.—December 4th. 12 water-tube boilers and superheaters, economisers, and feed pumps for the electricity department. See "Official Notices" November 15th.

Middleton.—December 2nd. The lighting of the electricity works. Particulars from Messrs. Lacey, Clirehugh and Sillar, 78, King Street, Manchester.

North-Eastern Railway.—December 9th. Tenders for telegraph stores for six months (1) Telegraph apparatus; (2) Telegraph wire and line stores. Forms of tender, &c., from Mr. Graves, Telegraph Department, York.

Nantwich.—January 6th. Water-tube and Lancashire boilers, c.c. steam dynamos, pumps and piping, switchboard, mains, posts, battery, meters, crane and dust destructor for the U.D.C. See "Official Notices" November 22nd.

Oban.—December 18th. Three 60-KW. steam dynamos, two water-tube boilers, economiser, &c., for electric lighting. See "Official Notices" to-day.

Pontypridd.—December 14th. Water-tube boilers, stokers, economisers, steam engines, dynamos, balancer, switchboard, workshop, crane and arc lamps, for electric power station. See "Official Notices" November 22nd.

Southampton.—December 14th. Electrical equipment of printing and other machines in the Ordnance Survey Office, Southampton. See "Official Notices" November 22nd.

Spain. — December 1st. Tenders to the Spanish Ministry of Posts and Telegraphs in Madrid for the supply of 11 tons of galvanised iron wire 4 mm. in diameter. Particulars from, and tenders to, La Direccion General de Correos y Telegrafos, Madrid.

Spain.—December 9th. The Municipality of Plencia (Biscay), Spain, will on this date consider tenders for the electric lighting of the town from 1902 till 1908. Particulars from the Secretary.

CLOSED.

Amsterdam. — The town authorities received the following offers for the overhead wires and certain other work for the new tramway system:—Allgemeine Electricitäts Gesellschaft, Berlin, 52,299·90 florins; Union Gesellschaft, Berlin, 48,330 florins; Helios Gesellschaft, Ehrefeldt, Cologne, 49,495·45 florins; Siemens and Halske, Berlin, 47,600 florins, and the Electricitäts Gesellschaft, of Neurenberg, 41,993·12 florins. No offer was made on behalf of either a Dutch, Belgian or British firm, all quotations being from German houses.

Battersea.—The Borough Council is obtaining quantities of cables, troughing, joint and other boxes, from Messrs. Callender's Cable Company, at £3,000.

Glasgow.—We understand that owing to the satisfactory working of the multiple telephone switchboard, which they made for the Glasgow Corporation, the Telegraph Manufacturing Company have received a large extension order.

Ilford.—We learn that Messrs. Dick, Kerr & Co., Ltd., have secured the contract for a 550-KW. Willans-English Electric steam generator for the Council's tramways supply.

Mansfield.—The T.C. has contracted with Messrs. Heenan & Froude for refuse destructor plant. Messrs. J. H. Williamson & Co. are to erect the buildings for the lighting and destructor works.

Wolverhampton.—In regard to our notice under this heading last week with reference to the tramway contracts under the B.E.T. Co., we learn that part of this contract, viz., that part running from the Town Hall, Bilston, through Bilston town, is to be carried out by Mr. George Law, of Kidderminster. He is also carrying out the one from the Fighting Cocks to Bilston for the same company, and has further secured two contracts in Stourbridge, viz., one commencing in High Street, Stourbridge, and terminating in the Urban District of Lye and Wollescote, and the other commencing from the existing tramways in High Street, Stourbridge, and terminating by a junction with the existing Kinver light railway in Bridgnorth Road. We are informed that the amount of Mr. Holloway's tender is not £70,000 or £80,000, but nearer £40,000.

Woolwich. — The M.B.C., in connection with their assisted wiring scheme, have accepted the following tenders:—

Contractor.	Price per point (including mains, main switch, distributing board, fuses, casing, leads, switches, lamps, lampholders, ceiling roses and shades.			
	Single light pendant.	Two-light pendant.	Three-light pendant.	Counter-weight fitting.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Norman Engineering Company.	0 15 6	0 19 0 Plain 1 0 0 Spider	1 1 0 Plain 1 3 6 Spider	0 17 6
Nunn, Watts & Co.	0 15 0	0 19 6	1 3 6	0 17 0

FORTHCOMING EVENTS.

Saturday, November 30th.—At 10.30 a.m. Institution of Electrical Engineers (Students' section). Visit to the generating station of the City and South London Railway.

Monday, December 2nd.—At 7.30 p.m. Society of Engineers. Meeting at the Royal United Service Institution, Whitehall.

Tuesday, December 3rd.—At 8 p.m. Institution of Civil Engineers. Ordinary Meeting. Paper to be further discussed :—"Train Resistance," by John A. F. Aspinall, M.I.C.E.

Note.—The next paper for consideration will be "Motive Power from Blast Furnace Gases," by Bryan Donkin, M.I.C.E.

Wednesday, December 4th.—At 7.30 p.m. Institution of Electrical Engineers (Students' section). Paper on "Some Electrical Testing Experiences," by Mr. H. D. Symons.

Thursday, December 5th.—Röntgen Society. Meeting.

At 8 p.m. Chemical Society. Ordinary meeting.

Friday, December 6th.—At 8 p.m. Institution of Junior Engineers. Meeting at the Westminster Palace Hotel. Paper on "Street Railway Construction for Electric Traction," by Mr. F. S. Pilling.

Saturday, December 7th.—City of London College Science Society to visit the works of the Baker Street and Waterloo Railway.

At 11 a.m. Institution of Electrical Engineers (Students' section). Visit to the Fulham Electricity Supply Works.

Tuesday, December 10th.—At 8 p.m. Institution of Electrical Engineers (Glasgow Section). Meeting in the rooms of the Institution of Engineers and Shipbuilders, 207, Bath Street.

NOTES.

More Electrical Volunteers for South Africa.—The following are fuller details of the latest arrangements regarding the sending out of another detachment of Electrical Engineers Volunteers to South Africa :—

Electrical Engineers, R.E.V.,
Regency Street, London, S.W.
November 22nd, 1901.

The Electrical Engineers Volunteers have already sent out three detachments to South Africa, and have carried out work of very great variety and importance. This work included lighting bridges during repair, lighting camps and hospitals, steam traction, bridge repairing, field telegraph and telephone work, and field and garrison search light work. The third detachment (of 100 men) is now in South Africa, and a fourth (of 50 men) has just been enlisted in compliance with the direct request of the Commander-in-Chief of the forces in South Africa. A fifth detachment of about 100 men is now called for, and those wishing to join must send in their names not later than December 5th, as favourable consideration cannot be accorded to late applications.

Men joining must be skilful tradesmen ; mechanical or electrical engineers, including fitters, blacksmiths, engine drivers, carpenters, joiners, wiremen and kindred trades, such as instrument makers and repairers. Telegraph and telephone hands are also wanted.

Unmarried men are preferred.

Applicants must be between the ages of 20 and 40, must be of good physique, at least 5 ft. 3 in. in height, and with a minimum chest measurement of 32 in. for this height.

The conditions of enlistment and pay are as follows :—

Enlistment for the remainder of the war, but should the war terminate within one year, men have the option of completing one year's service or taking their discharge at once.

Pay varies according to rank, and engineer pay according to skill.

Pay :—Sapper, 1s. 4½d. ; corporal, 2s. 9d. ; sergeant, 3s. 6d. a day. Engineer pay in addition to above. Fair tradesmen, 8d. ; skilled, 1s. ; superior, 1s. 4d. ; very superior, 1s. 8d. a day for days employed.

The following gratuities are payable on discharge :—Volunteer gratuity, £5 ; War Office gratuity, £5.

The third-class railway fare of applicants is paid provided they obtain the written consent of the Commanding Officer of this Corps to present themselves for approval. They must send sufficient particulars both as to physique and trade qualifications to enable the officer commanding to form an opinion as to whether they are eligible for service in South Africa.

Applications should be addressed to the Officer Commanding,
Electrical Engineers, R.E.V.,
Regency Street, London, S.W.

City of London College Science Society.—In consequence of the sudden illness of Mr. E. R. Calthrop, his paper which was to have been read on Wednesday evening on "Narrow Gauge Light Railways of Heavy Traffic Capacity" was postponed till further notice, but in his place Prof. Boulger read a paper on "Tin : A Chapter in the Early History of Metallurgy."

The Factory Acts. — The case of Crabtree *v.* Fern Spinning Company, which came before the Divisional Court on November 21st, is of considerable importance to the owners and occupiers of factories. By Sec. 9 (2) of the Factory and Workshop Act, 1895, it is provided that a person employed in a factory shall not be allowed to be in the space between the fixed and the traversing portions of a self-acting machine unless the machine is stopped with the traversing portion on the outward run. By Sub-sec. (3) it is provided (*inter alia*) that any person allowed to be in the space aforesaid in contravention of this section shall be deemed to be employed contrary to the provisions of the Factory Act, 1878. The penalty there provided is a fine not exceeding £10. In the case under notice, a boy employed by a spinning company entered a spinning machine while the traversing part was motionless but on the outward run. The man in charge, thinking that the boy was clear of the moving part, started the machine. The boy was caught by the machine on its inward run and sustained serious injuries. In these circumstances the spinning company were prosecuted by a factory inspector, who alleged that the machine had been stopped in such a position that when re-started the boy had no opportunity of escaping the moving part. The magistrates dismissed the complaint. The factory inspector appealed to the Divisional Court, when it argued that although the respondents had not committed an offence by allowing the boy to enter the machine when at rest, as soon as it commenced working he was unlawfully employed there, and that the magistrates ought to have convicted. The Divisional Court upheld their decision. The Lord Chief Justice said : "Although these Factory Acts ought to be construed strictly in the interests of the safety of life and limb, I think in this particular case the boy was not, either by the respondents or any one for whom they were responsible, allowed to be within this space." It seems to have been assumed that if the employer, or some responsible workman, had ordered or expressly allowed the boy to enter the machine, the penalty would have been incurred. The importance of the case lies in the fact that it gives a judicial interpretation to the words "shall not allow," which are so often used in the Factory Acts. It now appears that if in the absence of his employer or the foreman who has control over the machine, a child of his own free will enters the machine, the employer cannot be said to have "allowed" him to do so. As an instance of the importance of this case we would refer to the Factory Act, 1878, Sec. 9, which provides that "a child shall not be allowed to clean any part of the machinery in a factory while the same is in motion." If a child proceeds to clean a part of the machinery while it is at rest, and it is then suddenly started, without negligence on the part of the employer or any one in authority under him, it seems that no penalty would be incurred. The principle thus laid down may in our view be called in aid of the proposition that the word "allowed" as used in the Act means "authorised." It should be observed that the problem under discussion in this case arose under the older Factory Acts, which have frequently been considered in Courts of Justice during the past year. The new Factory Act of 1901, which comes into force on January 1st, contains almost the same words, and will therefore be subject to the same difficulties of interpretation which are giving rise to numerous cases under the older Acts. Time alone will show whether "codification," the avowed object of the new statute, means "simplification" of the law relating to factories and workshops.

Personal.—On Saturday, 16th inst., at the Royal Hotel, Barrow-in-Furness, Mr. H. R. C. Partridge (late manager of the Electrical Department at Messrs. Vickers, Sons & Maxim, Ltd., Naval Construction Works, Barrow), was presented with a beautiful gold English keyless watch by the officials and employés of the electrical and other departments of the works. The meeting was presided over by Mr. C. H. Robertson, and among those present was Mr. Long (Mr. Partridge's successor), and Mr. Padwick, head foreman of the Electrical Department. There were also present a fairly good representation of head foremen of other departments, and some 70 or 80 of the employés in the Electrical Department. In the course of the speeches it was said that during the three years Mr. Partridge had been with them great and rapid strides had been made under his management in the lighting of the yard and various departments, and in putting down motive power, which had now nearly superseded steam in all but one or two instances. Mr. Partridge is to occupy a similar position with the same firm at their Sheffield yard. The toast "Success to Messrs. Vickers, Sons and Maxim, Limited," was then proposed by Mr. Maidment (of Messrs. Clarke, Chapman & Co., Newcastle), in a few appropriate words, and Mr. Buchanan acknowledged.

Mr. C. H. Egan (Messrs. Egan & Tatlow), of Dublin, was presented with a handsome solid silver plate on the 19th inst. by his brethren in the electrical and engineering professions, on the occasion of his recent marriage.

Mr. L. Alwyn has recently retired from business as an electrical contractor, and has started in practice as a consulting electrical and mechanical engineer at 75 and 76, Terminus Chambers, Holborn Viaduct, E.C.

Glasgow Technical College.—Mr. W. R. Copland, M.Inst.C.E., the chairman, recently intimated that, including Mr. Carnegie's gift of £25,000, he had further anonymous gifts of £25,000 and £10,000, names of donors of which he could not divulge at present. The total rebuilding fund now stands at £169,600.

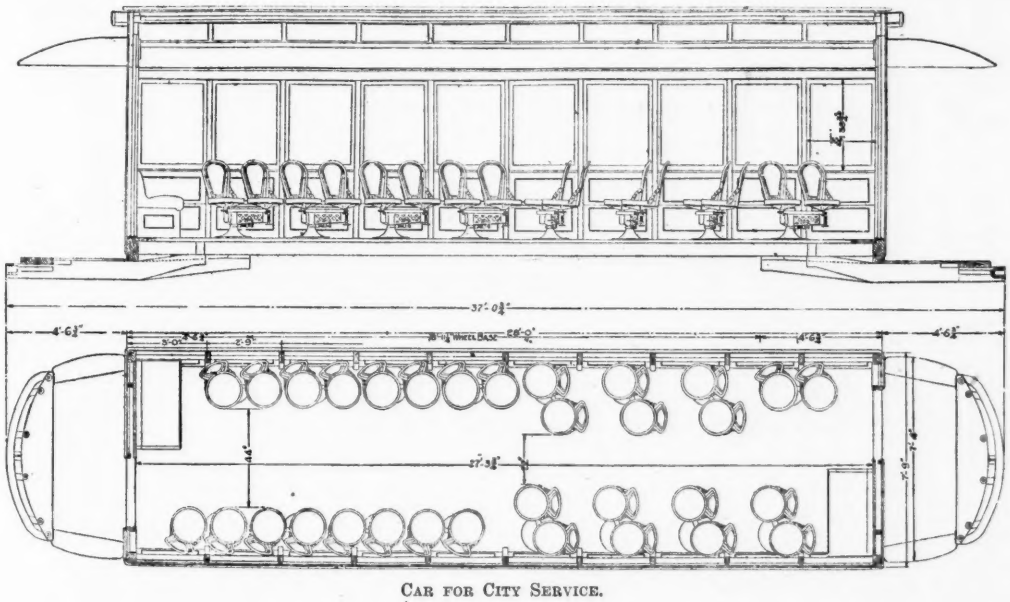
Society of Model Engineers.—The third annual conversazione of this Society is to be held at the Memorial Hall, Farringdon Street, E.C., to-morrow, Saturday evening, from 7—11 p.m.

Leeds Tramways.—With the vast increase of electric tram traction in Leeds the Crown Point generating station in that city is being rapidly enlarged to meet the augmented demand for power. There are three engines provided, two of which are kept working, and the third is held in readiness as a stand-by. Sufficient current is generated by them to provide power for between 150 and 200 cars. In a week or two, however, there will be completed a fourth engine of 1,450 I.H.P., and at the beginning of next year it is anticipated that still another will be ready. No fewer than 300 cars will then be provided with the necessary power by these engines. The generating station has six boilers in actual use, and four not yet in use.

Car for City Service.—Mr. Chamberlain, of the Brooklyn Rapid Transit Company, recommends a car of the following dimensions:—

Length over all	37 ft. $\frac{3}{4}$ in.
Length over corner posts	28 ft. 0 in.
Platforms	4 ft. $6\frac{3}{8}$ in.
Width over all at drip sill	8 ft. $\frac{1}{2}$ in.
Width over all at sills	7 ft. 0 in.
Width over all at steps	7 ft. 4 in.
Height from rail to top of trolley board ...	11 ft. $4\frac{1}{8}$ in.
Height from sill to top of trolley board ...	8 ft. $11\frac{5}{8}$ in.
Wheel base	18 ft. $11\frac{1}{2}$ in.
Twenty side window openings ...	$30\frac{3}{4}$ in. × $38\frac{3}{4}$ in.
Floor clearance, inside	27 ft. $3\frac{3}{4}$ in. in length
Floor clearance, inside	6 ft. 7 in. in width
Clear width inside at window sills... ...	7 ft. 1 in.

The appearance of this car with its ten small windows at each side of a 28 ft. body is distinctly inferior to later English cars, but this American car is of the combination type, intended to have the windows removed in summer time, so that a car may be changed to closed or open in 40 minutes. The seats of these cars are a novel feature, being of revolving type of cane or bent wood. They are so arranged as either to form a single row of seats along each side of the car, or they will swing out in pairs slightly at an angle with the normal to the car centre line, so that a central aisle of 22 in. is left. With these seats no passenger can give trouble by occupying more than one seat except with discomfort to himself. Some adverse criticism was directed against the car, especially in regard to the seats, the rear sitter being so placed as to have the more forward sitter too convenient for his encircling arm. Car morals do not seem to be elevated on some lines; but this seat arrangement certainly has its good points. Combined summer and winter cars do seem to be required in the American extremes of climate as a matter of necessity. Open cars are desirable in our own climate, but it is rarely so hot here that an electric car is uncomfortably heated by the sun, or that it cannot be cooled by the open front doors.



Car for City Service.

Glasgow Exhibition.—The balance sheet at October 31st, showed a balance in hand of £100,451. Among the various items of expenditure appear the following: Administration expenses, £42,295; coal and lighting, £7,392; illuminations and fireworks, £2,890; main buildings and laying out of grounds, £173,411.

Official Boiler Inspection.—In New York boilers are inspected by the police. The mixing of politics with steam boiler inspection is properly condemned by Mr W. E. Snyder in a paper read to a Pennsylvania Society. It appears that even a boiler inspector may be appointed for political reasons only. We do not find that our own Board of Trade is rendered inefficient through any such bad practice as prevails in American police circles, but we are quite of opinion that the inspection of land boilers is no proper duty for the Board of Trade, and that any such interference of an official body would be most serious. Officialdom is invariably inclined to become lazy and overbearing, and official inspectors would undoubtedly become very arbitrary in shutting down boilers for trivial defects, and thereby cause serious loss, inconvenience, and injury to traders. The remarkably low average of accidents to English land boilers, as compared with other countries where more official inspection prevails, is an undoubted sign that established English methods have proved good and satisfactory. The English records are creditable to the boiler inspection and insurance companies, and form a complete answer to busybodies who would bring in official meddling. Nor can we more approve of the call for literary examinations of stokers. Mere literary attainments are no indication of working ability. A knowledge of the natural sciences is of very little aid to a man in his regular attendance upon a steam boiler, and will not even help him to fire well or prevent smoke. All these things come by experience, and we might point out that a knowledge of chemistry and physics did not for many long years teach even educated engineers that the best course to pursue with a red hot boiler was to cool it as quickly as possible. They all held the idea that quenching the hot plates would produce an explosive pressure in direct negation of the plain facts as to temperature and specific heat. The experiments on red-hot plates made by the Manchester Steam Users' Association a few years ago, quite exploded the idea of danger, and pointed to the probability that the best position for feed inlet is above the points liable ever to become overheated. We would not condemn study by the humblest workman, as it would certainly add interest to his work, but we are sure that some of the examinations called for by examination faddists would cost the services of many of the best men affected. The craze for examinations will become a disease.

Foolish Striking.—There has now been in progress at the works of Messrs. Hy. Berry & Co., Limited, Leeds, a strike which has neither reason nor argument to support it. Four years ago the two-break day was introduced into these works. It suited the men and has worked well. It may be remembered that in 1897 Mr. John Burns called on the employers to adopt American methods. Now, American methods include piece work, a week of 60 hours, one man to as many machines as he can attend, and the two-break day. Mr. Burns at the time he made his demand was helping a strike movement that was dead against the first three of the above items, and his attitude in speaking in favour of the methods against which he was helping the A.S.E. to fight was very incomprehensible, but not more so than is the attitude of these Leeds strikers. Whatever may be said against the two-break day with the longer hours in America does not apply to the system in this country. It is worked in many English shops, and can be easily managed outside London, where the difficulty of morning trains and overcrowding not only makes the system impracticable, but is also driving out the engine shops from London to the country, where better hours can be kept. At the Leeds shop the hours are 7.15 to 12 for the morning shift, then from 1.0 to closing time. There has been no complaint from the men. Four months ago

the men's union wrote and demanded a change. The matter was referred to the local committee of the Employers' Federation and Union Executive, again referred by them to the London headquarters of each body, and by these sent back to Leeds as a purely local dispute. Upon that, with no further parley, the local union declared a strike, which has been accompanied by picketing and intimidation. It is said that large numbers of the men really interested prefer the existing two-break day, but are afraid to defy their local society. If not arising from the action of some local busybody, for whose idle hands his master has found mischief still to do, we fear that this paltry and entirely useless and needless strike is in the way of a feeler. It is so entirely capricious, if not at bottom of serious intent, that the Employers' Federation ought, in our opinion, to intervene, and is not justified in calling this a purely local dispute. In a country town like Leeds, where men can get to their work as late as they like, it passes all comprehension that they should want to turn out, so to speak, in the middle of the night.

Electrical Safety Appliances.—On 12th inst., before the Students' Engineering Society, University College, Liverpool, Prof. Hele-Shaw in the chair, a paper was read by Mr. P. H. Powell, B.Sc., on "Electrical Safety Appliances." Mr. Powell first alluded to the necessity of providing means to prevent live conductors charged at high voltages commonly in use at the present day, coming in contact with people, and went on to describe one of the first systems in use, viz, that of protecting the trolley wire on tramway circuits by fastening long pieces of cane over it. The system has many objections, most of which, as well as its general application, being generally well known. Another method was to use guard wires placed above the conductor, in the same plane, and about 18 in. apart. These wires are sometimes, though not always, insulated. Mr. Powell said he did not see much use in insulating them, as if a broken telephone wire came in contact with the conductor as well as the guard wires, it were better that the guard wires should be well earthed, when a short circuit would result, causing the fuses in the section boxes to blow. He also described (1) Canter's device of having the guard wires laid transversely under the wire to be protected, and lead weights attached to the telephone wires, causing them to come in contact with the guard wires if broken; (2) Quiris's system of having a pilot wire lead from the far end of the section supplied to the switch pillar and connected to the shunt coil on the switch, so that in the event of a stoppage of the current through the coil, the latter allows the core to fall, knocking up a catch and releasing the switch lever, which is forced out by a spring, and thus cuts off the trolley wire from the feeder; (3) the Ulbricht earthing method which depends on the principle of a momentary connection between the trolley wire and the earth, establishing a direct communication between the same, this connection remaining until the apparatus is re-set; (4) Bostock and Cheetham's plan, of service only in the case of the trolley wire breaking, and of which Mr. Powell gave the inventor's description; (5) C. J. Mescurier's device providing against accidents due either to the overhead conductor breaking or telephone wires falling across it. A description of several brakes was then given, including the "slipper," air, and electric types, an advantage of the last named being that the frequency of stoppage does not matter, as it is the current from the motors driven from the cars itself which furnishes the brake. The "Eddy current and friction" type of brake, in which there are three different actions at one and the same time, tending to stop the car, and the Westinghouse brake, which is also of triple action, combining track brake, wheel rim brake, and axle brake.

Institution of Electrical Engineers (Glasgow Section).—This section held its opening meeting for the session at the Institute of Engineers and Shipbuilders, 207, Bath Street, Glasgow, on Tuesday, 19th inst., Prof. Magnus Maclean, president-elect in the chair. The minutes of the last meeting having been read and approved, the chairman referred to the quality and interest of the papers, several having been published in the *Proceedings* of the parent institution, and the section had had the satisfaction of being the first and, up to the present, the only local section to secure an Institution premium for a paper read at a local meeting, the Institution having awarded to Mr. Michael B. Field a premium for his paper on "A Method of Compensating Voltmeters for the Voltage Drop in Long Feeders," which was read at the meeting on February 13th last. He therefore had much pleasure in presenting Mr. Field with a planimeter and a bound set of the back numbers of the Institution *Proceedings*.

Proceeding with his address, Prof. Maclean said: I desire to take this, the first opportunity, of thanking you for the honour you have done me in electing me your chairman for this current session.

Since we met in May last we have had meetings of a very large number of scientific societies in Glasgow. At these meetings a considerable number of electrical papers were read. Indeed, at the Electrical Section of the Engineering Congress so many papers were prepared at the request of the Council of the Institution that there was no time given to some of the authors to even adequately summarise them to the meeting, and none at all for discussing some of them. So much electrical information has been thus given to us during the last summer and autumn, that you might reasonably expect us to spend this session in digesting it, and not aim at getting more papers read to us. But no; the Committee of this local section of the Institution have had offers of papers as usual, and you will have noticed from the circular the secretary issued to you recently that we have had already promises of sufficient papers for this session.

Again, we had a successful International Exhibition in our midst. A paper describing and discussing the developments and improvements that have taken place in electrical engineering apparatus during the last 13 years, as illustrated by the electrical exhibits in the 1901 Exhibition and those in the 1888 show, would be most instructive.

In connection with the application of electricity to electric lighting, I should mention the Nernst lamp which was shown in actual operation in Scotland for the first time last September, when Lord Kelvin switched some of them on at the stand of the Electrical Company at the Exhibition. Through the kindness of Mr. Buhler samples of the Nernst lamp are on the table for your inspection. I expect a great future for lamps constructed on the Nernst principle.

At the last meeting in May, Mr. Walter Jamieson showed those present some experiments on high frequency oscillations by apparatus mostly of his own devising and all of his own construction. A desire was expressed that an opportunity should be given to him to repeat some of these experiments and show some others, the apparatus for which he had no time to prepare on the previous occasion. He is present this evening to experimentally illustrate some of the more elementary facts and results of observation and experiment in the subject of electric oscillations.

The first reference we have to the discharge of a condenser being oscillatory, is in a remark by Prof. Joseph Henry in 1842, and the second reference is an essay by Von Helmholtz in 1847. The outstanding important date is, however, in 1853, when Lord Kelvin showed that the discharge would be oscillatory or continuous, according as R^2 is less or greater than $\frac{4L}{K}$ where R is the resistance, L the inductance, and K the capacity of the circuit, and all the factors expressed in consistent units. Thus when R^2 is greater than $\frac{4L}{K}$, the discharge is unidirectional, and when R^2 is less than $\frac{4L}{K}$ the discharge is oscillatory. (Illustrative curves were drawn on the blackboard.)

Expressions for the capacity and inductance of simple circuits were then given by Dr. Maclean, and also illustrative examples of how to calculate the frequency and wave lengths of commonly used oscillators. With the oscillators on the table and used by Mr. Jamieson in his experiments, wave lengths from a few miles long to a few inches were produced, giving frequencies from a few hundreds to thousands of millions.

Mr. Jamieson's experiments, carried out with a great variety of specially constructed apparatus, were followed with great interest and attention, as were also his explanations of the phenomena which he produced. A hearty vote of thanks, proposed by Dr. Maclean, was passed in favour of Mr. Jamieson.

Mr. H. A. Mavor, member, begged formally to move a vote of thanks to Dr. Maclean, which evoked a hearty response.

A New Calcium Carbide Syndicate.—In spite of the collapse of the syndicate of Central European carbide manufacturers which was founded a year or so ago, a new attempt to form a combination or "ring" on more inclusive and international lines has recently been made. This second combine is to be managed as a limited company, with its headquarters at Nürnberg; but at the moment of writing it seems doubtful whether all the necessary arrangements have actually been effected, as one or more important members of the trade are reported to be standing aloof, at least for the time. Nevertheless, the syndicate has already felt itself strong enough to announce as a first step that it intends to increase the price of calcium carbide in Germany, &c., and it has fixed that price at 290 marks per 1,000 kilos c.i.f., Hamburg, Stettin, and Antwerp, which is roughly equal to £14—£15 per English ton. In view of the fact that carbide could be bought lately in Germany at 22 marks per 100 kilos, the threatened increase appears rather a serious matter, and too sudden a stroke to deliver all at once; since it is estimated that the above wholesale price corresponds with a dealer's figure of 33—35 marks per 100 kilos (say, 16s. 6d. to 17s. 6d. per cwt.) in favourably situated parts of the country. If this price can be established and maintained by the syndicate, it will prove a heavy blow to the German acetylene industry; for at present prices, owing to the cost of paraffin, coal, and, therefore, coal-gas and electricity, being frequently higher than in small English towns, acetylene was able to compete on easy terms with its several competitors; and the business would seem to have been pushed for some months on the assumption that those carbide prices were fairly permanent. Already there are threats of a counter-combination on the part of the acetylene users. In America, it may be interesting to remember, the price of carbide delivered f.o.b. cars at most large towns is $70 per ton, or nearly the same as the English price of £16 per long ton.

Manchester Electrical Contracts. — We understand that the tender of the Electrical Company, Limited, to the Manchester Corporation for two 6,000-H.P. engines and three-phase generators, as well as for the motor-generators, has been recommended for acceptance. We believe that the price submitted was £113,000.

Accident on the Central London.—A stockbroker accidently fell in front of a train at Marble Arch Station on the morning of the 25th inst. and was instantaneously killed. The train came to a standstill and the lights were put out.

"It's an ill wind," &c.—An Aberdeen cab proprietor has failed, and at his examination he said that the competition of electric cars and motor cars had killed his business completely.

London Electrical Contractors' Association.—An enthusiatic meeting of this association was held on Wednesday, 27th inst., at Anderton's Hotel, Mr. W. R. Woodward in the chair. In welcoming those present, the president dwelt on the substantial progress made in London, and the large accession of membership, referring in sympathetic terms to the retirement of Mr. S. Frost from the secretaryship. Mr. W. R. Rawlings followed with an exposition of the aims and objects of the association, drawing attention to their endeavours to improve the workman by granting certificates of efficiency and raising the status of the electrical contractor. A general discussion of this latter point followed. The question of trade discounts was dealt with exhaustively by Mr. C. Troup, who impressed the importance of a satisfactory settlement of this point, and though but a subsidiary object of the association it was important, inasmuch as the question was one daily brought home to the electrical contractor. The speaker hinted at the possibility of establishing a supply house under the co-operative system should such a course be rendered necessary. The present injustice of municipal competition, and the impending prospect of further developments to the detriment of the contractor, was pointed out by Mr. W. Gillard, the speaker instancing the case of a Borough Council, who under-quoted to such an extent, that a large firm of ratepayers had to abandon their contracting business; the prospects of Borough Councils and other municipal bodies using public money to deprive their ratepayers of their livelihood, enforces the necessity of united action to check this growing evil. The Committee was strengthened by two additional members.

Business Announcements.—The Electric and Ordnance Accessories Company, Limited, have now taken over the business formerly carried on by the British Electric Works Co., Limited, and in the course of a few weeks they expect to be on the market for the purpose of supplying electrical material as hitherto. We are informed that at present they are hard at work re-organising and putting into working order the telephone, switch, dynamo, motor and electrical accessories departments, so that prompt attention to all orders entrusted to the new company may be assured.

Mr. A. H. Hunt informs us that his warehouse and office at 59, Gresham Street, E.C., were entirely burnt out on the night of Monday last. Mr. Hunt will be installed in temporary quarters in a day or so, pending the rebuilding of his old premises; meanwhile his postal address is as hitherto, and all orders will receive his prompt attention.

Appointments Vacant.—A junior assistant is wanted for Cheltenham generating station; an electrician to superintend electric lighting and motor plant, &c., at the Hereford County and City Asylum; electrical engineer for Rhyl electricity works at £150; junior assistant for Bury electricity works at £65; accountant secretary for the Harrow Electric Light and Power Company at £150.

Large Contract for Prepayment Meters.—We learn that the Schattner Electricity Meter Company, Limited, have this week secured a record contract for prepayment meters. We mentioned some weeks ago that Mr. J. Newton Stephens, the engineer and manager of the Liverpool branch of the ubiquitous National Electric Wiring Company, Limited, had secured the contract for the complete electric lighting of Vickerstown, Barrow-in-Furness, where over 1,000 houses are being erected, principally for the employés of Messrs. Vickers, Sons & Maxim, Limited. Not only are these houses to be fitted with electric light, but they are all to have Long-Schattner prepayment meters (6d. in the slot).

Bankside Plant for Sale.—The City of London Company is open to sell eight vertical compound engines (300 to 100 H.P.); ironclad alternators (170 and 70 KW.); arc lighters, crane, fittings, meters, &c. See our advertisement pages for details.

Native Calcium Carbide.—It has been announced in a Russian paper that a mine or deposit of calcium carbide has been discovered on the right bank of the river Waga, 20 versts from the town of Schenkensk, in the province of Archangel. This valuable piece of intelligence is surely equal to any of the efforts of our half-penny press.

The Eagle Screaming in the Lion's Den.—In his speech to the shareholders of the British Westinghouse Company, Mr. Geo. Westinghouse remarked that he found his name here best known in connection with the Westinghouse brake. In some respects the application of the brake to the speaker's remarks would not have been out of place. He found that the recent opening of the Central "tube" had awakened us to the advantages of electric traction as carried out in America. Apparently there was no shareholder to remind his chairman that the "tube" system was not known in America, that it was designed by an English "Greathead," electrically equipped by British makers, and had been in operation under Londoners' very noses for the past 10 years!

New York Subway Line.—During their recent visit to the Continent the officials of the New York Rapid Transit line paid a visit to the steam turbine and electric works of Messrs. Brown, Boveri & Co., in order to ascertain what progress had been made in the development of steam turbines as applied to electrical machinery.

Lectures.—On 25th inst. Mr. J. Wilson, of Loughborough, lectured to the members of the Yorkshire College Engineering Society on the "Development and Utilisation of Electric Power for Traction."

Before the Edinburgh Association of Science and Arts, on 18th inst., Mr. E. G. Craven, editor of the *Scottish Electrician*, lectured on "Electricity: Past, Present and Future."

Sir William Roberts-Austen will deliver the tenth "James Forrest" lecture at the Institution of Civil Engineers on April 17th, the subject being "Metallurgy in Relation to Engineering."

It is announced that Mr. G. M. Freeman, K.C., will read a paper on "The Problem of the Tubes," at a meeting of the Auctioneers' Institute, to be held at the Medical Examination Hall, Victoria Embankment, on Wednesday, December 4th, at 7.45 p.m.

At a meeting of the Manchester Association of Engineers held on Saturday, Mr. T. T. Heaton (London) read a paper on "Electric Welding."

THE CENTRAL STATION ENGINEER.

On 20th inst., in the office of the Aberdeen Electricity Works, Cotton Street, Mr. Pat. R. Monro was made the recipient of a set of four valuable technical books on electricity and allied subjects on the occasion of his leaving to fill a vacancy on the staff of the County of Durham Electric Supply Company at Gateshead. Mr. Bell complimented Mr. Monro on his having been successful in securing this post, and regretted that he had now to lose his services. Mr. Monro very feelingly replied. He took up his duties at Gateshead last week.

Mr. J. E. Edgcome, electrical engineer to the Kingston Corporation, makes quite a hobby of his work as secretary of the local lifeboat fund committee, which this season has handed over £80 to the National Lifeboat Institution.

At the New Brompton Electricity Works on Saturday evening last, Mr. A. C. J. Reynolds, junior assistant engineer, was presented with a Gladstone bag on his leaving to take up an appointment under the Charing Cross and Strand Electric Supply Company The presentation was made on behalf of the subscribers by Mr. A. J. Ryan, A.I.E.E., chief assistant engineer.

The two vacancies which, as stated last week, have been filled by Messrs. Briggs and Mackersie, are at the Bradford Corporation electricity works.

Mr. A. J. L. Plunket, who has been power superintendent to the Kidderminster and District Electric Lighting and Traction Company, Limited, for some time, has been appointed engineer to the Merthyr and District Electric Traction and Lighting Company, Limited.

The third annual supper of the employés of the Dundee electricity station was held on 20th inst., Mr. W. H. Tittenson presiding.

Mr. Edward Calvert, chief engineer at the Buxton electricity works, is taking up the appointment of chief electrical engineer to the Finchley District Council, to prepare a scheme for supplying their district. Hereafter, Mr. Calvert should be addressed "Electricity Department, Finchley District Council, Finchley, N."

NEW COMPANIES REGISTERED.

London United Tramways (1901), Limited (17,844).—This company was registered on November 11th, with a capital of £1,650,000 in £10 shares (82,500 5 per cent. cumulative preference), to take over and carry on the business of the London United Tramways, Limited, to acquire as a going concern the undertakings, tramways and light railways authorised by the London United Tramways Acts, 1873 to 1901, and by the London United Tramways, Limited (Light Railway Extensions) Order, 1898, and the rights, powers and authorities thereunder as provided for, and contemplated by Section 45 of the London United Tramways Act, 1901, or as otherwise authorised, and all or any other undertaking, property and assets of the said London United Tramways, Limited, to adopt an agreement with the said company, to acquire or construct, maintain and work any tramways, railways, or light railways, whether on, under or above the surface, and whether worked by electrical, steam, horse, or other power, and to carry on the business of tramway, railway and light railway proprietors, owners of stage coaches, Hackney carriages, cabs, omnibuses, vans and cars, keepers of livery and bait stables, ship and barge owners, carriers of passengers and goods by land and water, &c. The first subscribers (each with one share) are:—G. White, Clare Street House, Bristol, chairman of Bristol Tramways and Carriage Company, Limited, and Imperial Tramways Company, Limited; E. Everard, 28, Broad Street, Bristol, printer and publisher; H. C. Godfray, 42, Finsbury Square, E.C., director of Imperial Tramways Company, Limited; J. C. Robinson, 88, High Road, Chiswick, W., managing director and engineer of London United Tramways, Limited; S. White, Clare Street House, Bristol, managing director of Bristol Tramways, Limited; H. G. Doggett, 18, Clare Street, Bristol, solicitor; W. G. V. Smith, Clare Street House, Bristol, tramway companies' secretary. The number of directors is not to be less than two nor more than five; the first are G. White, E. Everard, H. C. Godfray, J. C. Robinson, S. White; qualification, £5,000; remuneration as fixed by the company.

Telegraph Manufacturing Company (Colonial), Limited (71,854).—This company was registered on November 12th, with a capital of £2,000 in £1 shares, to carry on in any British colony, dependency or possession in South Africa or elsewhere, or in the United Kingdom or elsewhere, the business of electrical, mechanical and general engineers, contractors, manufacturers of and dealers in wires, cables and all kinds of electrical appliances, materials and apparatus; contractors for the construction, equipment and maintenance of tramways and railways with electric or other power, telephone

and telegraph proprietors, suppliers of electric light, heat and power, &c. The first subscribers (with one share each) are:—J. Brotherton, The Cottage, Helsby, secretary; E. R. Pearson, Grange View, Victoria Road, Runcorn, clerk; G. Seddon, 44, Lightfoot Street, Hoole, Chester, cashier; E. A. Ward, 50, York Street, Runcorn, clerk; W. Woods, 116, Faulkner Street, Hoole, Chester, clerk; C. F. Kniveton, 17, Cawley Street, Runcorn, clerk; and H. Knight, Hoddesdon Mount, Helsby, Cheshire, clerk. No initial public issue. The number of directors is not to be less than three nor more than five; the first are James Taylor, M.I.E.E. (chairman), Heathercliffe, Helsby, manufacturer; G. C. Taylor, Ravenscar, Helsby, manufacturer; F. Whiteley, Oakcliffe, Helsby, manufacturer; and J. S. H. Banner, North John Street, Liverpool, chartered accountant.

Broadhurst & Co., Limited (71,885).—This company was registered on November 15th, with a capital of £10,000 in £1 shares, to acquire and take over as a going concern the business of india-rubber manufacturers hitherto carried on by James Robinson and William D. Waddell as "Broadhurst & Co.," to adopt an agreement with the said vendors, and to carry on the business of manufacturers of india-rubber, india-rubber goods, waterproofs, leather goods and electric cables, government and general contractors and purveyors, &c. The first subscribers (each with one share) are:—T. Chorlton, Oak House, Audenshaw, Lancashire, solicitor; A. Lawley, Oaklands, Alderley Edge, Cheshire, merchant; W. H. Fawsitt, 344, Oxford Road, Manchester, secretary; A. E. G. Chorlton, Waveney, Prestwich Park, Prestwich, Lancs., solicitor; C. Dreyfus, Claremont, Fallowfield, Manchester, chemical manufacturer; T. C. Middleton, West Lea, Urmston Lane, Shetford, Lancs., chartered accountant; and Miss A. A. M. Chorlton, Oak House, Audenshaw, Lancs. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are Robert Hindle, Thomas C. Middleton, John B. McKerrow, and one more to be appointed by the subscribers; remuneration as fixed by the company. Registered office, 82, Market Street, Manchester.

Yorkshire (Woollen District) Electric Tramways, Limited (71,916).—This company was registered on November 19th, with a capital of £300,000 in £5 shares, to carry on in the United Kingdom and elsewhere, the business of carriers of passengers and goods, electrical engineers, electricians, engineers, contractors, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic and other apparatus, mechanical and chemical engineers, generators, accumualtors, transmitters, users and suppliers of light, heat, sound and power by electricity, galvanism, magnetism, compressed air, gas, steam or oil, or any of them or otherwise, patent owners, manufacturers of machinery and plant, tramway and railway contractors, workers of tramways and railways by electricity, steam, oil, gas, petroleum, horse or other power, car, carriage and vehicle builders, &c. The first subscribers (each with one shares) are:—Emile Garcke, Donington House, Norfolk Street, Strand, W.C., managing director of the British Electric Traction Company, Limited; Thomas Pilkington, Bart., Chevet Park, Wakefield; Charles H. Dade, Donington House, Norfolk Street, Strand, W.C., secretary of the British Electric Traction Company, Limited; W. J. Greer, 58, South Eaton Place, S.W., director; Ernest H. Hopwood, 35A, Hertford Street, Coventry, secretary; E. A. Paris, Cross Trees, Gomersal, near Leeds, director; A. L. Barber, 56, Clarendon Road, Notting Hill, W., secretary. No initial public issue. The number of directors is not to be less than 3 nor more than 7; the subscribers are to appoint the first; qualification, one share; remuneration, £50 each per annum and 5 per cent. of the dividend paid on the ordinary shares, divisible. Registered office, Donington House, Norfolk Street, Strand, W.C.

Grant's Drill and Trolley Company, Limited (71,933).—This company was registered on November 21st, with a capital of £7,000 in £10 shares, to adopt an agreement between R. G. Grant, P. C. Pope, and J. F. Simpson, of the one part, and this company of the other part, to acquire any patents relating to boring drills, or to holding or driving the same, or to the manufacture of electric tramway equipment, or to other improvements in connection with machinery, and generally to carry on the business of boring drill and electric tramway equipment manufacturers, iron founders, boring and sinking contractors, mechanical engineers, tool makers, boiler makers, metal workers, millwrights, machinists, iron and steel converters, wood workers, builders, paint manufacturers, painters, metallurgists, electrical and water supply engineers, hardwaremen, manfacturers of rolling stock, &c. The first subscribers are:—P. C. Pope, 56, Liverpool Road, Birkdale, electrical engineer, with ten shares; J. S. Dyas, 38, Earl Street, Wigan, engineer, with one share; W. W. Seed, 36, Walmer Road, Birkdale, electrician, with five shares; R. G. Grant, Rhos-on-Sea, Colwyn Bay, electrical engineer, with ten shares; A. Grant, Rhos-on-Sea College, Colwyn Bay, principal, with one share; H. G. Heehle, Llandrillo-yn-Rhos, Colwyn Bay, gentleman, with ten shares. No initial public issue. The first directors are R. G. Grant, H. G. Hechle, P. C. Pope, and J. F. Simpson; qualification, £100; remuneration as fixed by the company.

Benfleet Electric Light and Engineering Company, Limited (71,945).—This company was registered on November 22nd, with a capital of £5,000 in £5 shares, to adopt an agreement with D. Paisley and D. Varty, to supply the parishes of South Benfleet, Thundersley, Canvey Island, Hadleigh, Bowers Gifford, Pitsea, Vange, North Benfleet and Rayleigh, or any of them, with electricity or gas, to manufacture, sell and supply light, and to carry on the business of electrical and general engineers, gas makers, &c. The first subscribers (each with one share) are:—D. Paisley, 17, Coleman Street, E.C., engineer; H. C. Reis, 90, Leadenhall Street, E.C., clerk; T. Durant, 5, Guildhall Chambers, E.C., solicitor; J. U. Brooks, Hawkswell, Hockley, Essex, clerk; G. Williams, 68, Lincoln's Inn Fields, W.C., gentleman; F. B. Seymour, 32, Hampton Road, Forest Gate, clerk, and R. C. Varty, Jarvis Hall, Benfleet, surveyor. Minimum cash subscription 60 shares. Registered without articles of association. The first directors are D. Paisley, E. A. Helffenstein and R. C. Varty. Registered office, 89—90, Leadenhall Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Electrical Manufacturing Company, Limited (69,471).—Particulars of registered mortgages and charges. Total amount secured by series of debentures, £2,000; date of resolution creating series of debentures, April 2nd, 1901; property charged, the undertaking and property of the company, present and future, including uncalled capital; date of present issue, April 16th, 1901; amount of present issue, £2,000 in 20 debentures of £100 each; no trustees.

SUPPLY STATION ACCOUNTS.

Taunton Corporation Electricity Accounts.

In every direction the accounts for last year of the Taunton Corporation undertaking show improvements and mark progress. The reorganisation of the works has resulted in reduced cost and cheapened supply, while the financial result is comparing well with what might have been anticipated from the figures of previous years. Mr. E. B. Thornhill has the credit of the improved costs as resident engineer, but he, no doubt, would be the first to admit what the late engineer, Mr. Couzens, has done for the department in the capacity of representative of the consulting engineers.

General Statement.

	1899.	1900.	Inc.
Total capital expenditure ...	£41,369	£47,627	£6,258
Number of units sold	215,620	307,179	91,559
Maximum load in kilowatts ...	243	320	77
Gross revenue	£5,010	£6,649	£1,639
Gross expenditure	£2,805	£3,638	£833
Gross profit	£2,205	£3,011	£806
Average price per unit sold ...	5·29d.	4·62d.	—·67d.

The revenue derived from the sale of energy has fallen by over ¾d. per unit, which is half as big again a decrease as was recorded for the comparison of 1898 with 1899, and in this period of two years the consumer has reaped the benefit of a fall from nearly 5⅝d. to less than 4⅛d. The output has more than doubled in the same relative times. The detailed figures for the last three years are:—

	Units generated.	Sales private.	Public lighting.	Total sold.	Number of public lamps.
1898 ...	225,958	105,853	65,230	171,083	58 arcs, 8 50-C.P., 2 32-C.P., 45 16-C.P., 40 8-C.P.
1899 ...	271,780	133,866	81,754	215,620	67 arcs, 8 50-C.P., 8 32-C.P., 105 16-C.P., 36 8-C.P.
1900 ...	434,762	178,200	128,979	307,179	72 arcs, 8 50-C.P. 15 32-C.P., 130 16-C.P., 32 8-C.P.

Revenue Statement.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£4,751	5·29d.	£5,914	4·62d.	—·67d.
Meter rents	144	·16d.	184	·14d.	—·02d.
Sales of lamps and other apparatus and work done	58	·07d.	496	·39d.	+·32d.
Sundry rents received and pupils' premiums	57	·06d.	55	·04d	—·02d.
Gross revenue ...	£5,010	5·58d.	£6,649	5·19d.	—·39d.

In the costs we have included the material used and lamps sold as well as proportion payable on free wiring, but if these are excluded the costs are reduced by £539, and the revenue account then contains a profit of £151 made on work done and sales, but allowing for the free wiring it is reduced by £43 after absorbing this profit item.

Coal has slightly increased in the gross, but shows the substantial saving of over $\frac{1}{10}$d. per unit, and more or less important reductions have been made on all the other items of expenditure, so far as they affect generation and distribution. Oil, waste, &c, has been brought down also in the gross, showing the economy of the altered plant.

Cost of Production.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal and unloading same ..	£1,029	1·15d.	£1,328	1·04d.	—·11d.
Oil, waste, water, and engine room stores and carbons.	208	·23d.	175	·14d.	—·09d.
Salaries and wages incurred in generation and distribution & attending street lamps	534	·59d.	544	·42d.	—·17d.
Repairs and maintenance of buildings, boilers, engines and dynamos, and renewals of street lamps.	177	·20d.	248	·19d.	—·01d.
Works costs	£1,948	2·17d.	£2,295	1·79d.	—·38d.
Rent, rates and taxes ..	78	·09d.	112	·09d.	·00d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	535	·59d.	588	·46d.	—·13d.
General establishment charges, stationery and printing, law charges and insurance	105	·12d.	104	·08d.	—·04d.
Other expenses: royalties or fees on free wiring, and materials for installations and lamps sold.	139	·15d.	539	·42d.	+·27d.
Total costs ...	£2,805	3·12d.	£3,638	2·84d.	—·28d.

The profits have increased by £806 in the gross, and after setting aside an extra £603 for financial charges, by £203 in the net. Taking into account a credit balance of £94, the district rate has again had £300, and £50 remains to be carried forward. Taking the last four years we get:—

	Net profits.		Allocated,	
1897	£44	To rates	£600	
1898	751	To renewals and reserve fund ...	1,354	
1899	503	Balance	50	
1900	706			
	£2,004		£2,004	

The figures below deal with the year's working only.

Profit Statement.

	1899.	1900.
Interest on loans and overdraft	£975	£1,349
Sinking fund for repayments	727	956
Net profit carried to reserve fund	203	450
" " to credit of general rate	300	256
Gross profit	£2,205	£3,011

CITY NOTES.

Marconi International Marine Communication Company.

The first annual meeting of this company was held on Thursday last week at the offices, 18, Finch Lane. Major S. Flood Page presided, and in moving the adoption of the report, remarked that the object for which the company came into being was to work throughout the world, except in the United States, Hawaii, Chile, and the Colonies or dependencies of those States, an exclusive license, for all maritime purposes, granted by the Marconi Wireless Telegraph Company, Limited. In the prospectus, there was also a paragraph excluding from the license the British Navy and the Italian Navy. The directors had been engaged in England, and in many parts of the Continent, in using their influence to further the adoption of Marconi wireless telegraphy for maritime purposes by all countries on an international basis, and they were well satisfied with the success so far obtained. If sea telegraphy were to be exercised freely, it was evident that there must be land stations with which ships having the Marconi apparatus could communicate. A number of such stations had already been established by this company in different parts of the United Kingdom, as well as in Belgium and Germany. In addition, other stations had been equipped by the parent company in the United States, and one was now being equipped at the entrance to the Gulf of St. Lawrence. The greater part of the period under review was taken up in negotiations, and in laying the foundations of the business. The company had entered into an important arrangement with Lloyd's, under which they had definitely adopted the Marconi system, and would not use any other system of wireless telegraphy. They had undertaken to install signal stations for Lloyd's, which that institution would also work for passenger and commercial traffic for the benefit of this company. The experiments which had led to the adoption by Lloyd's of the Marconi system extended over a long period. Referring to the conditions on which the Marconi system was used on large steamships, he said that the owners of the vessels supplied the masts, and made all necessary additions on board, and this company supplied and worked the apparatus. The steamship was entitled to transmit a certain number of words, but this company received all money derived from sea telegraphy. The board proposed to fit up all first-class passenger steamships on like terms, but different terms would be offered for cargo vessels where there would be practically no sea telegraphy, but only what might be called signalling. As an indication of the possibilities of the system, he said that the *Lucania* and *Campania* talked together when 36 miles apart for a distance of 140 miles. The development of the system could not reach its full growth until there were stations established. which the vessels could freely use, on both sides of the Atlantic. When ample provision of that kind was made, there would be a great increase in the use of the system by steamships. The Cunard Company, the Norddeutscher Lloyd, La Compagnie Transatlantique, the Beaver Line, and others, besides the Belgian Mail Packets, were already successfully employing the Marconi apparatus on their vessels. Fog and storm made no difference to the efficient working of the system. Its installation on all large steamships must minimise considerably the risk which underwriters ran, and so lead to a reduction in premium for insurance.

The report was adopted.

The Petroleum Engine Company.

The directors' report for the year ending June 30th, 1901, shows that the royalties received for the year amount to £164 14s. Messrs. Priestman Bros., Limited, has now been reconstructed, and is free from the restrictions of trading under the supervision of the Court. To meet the keen competition in the oil engine trade Messrs. Priestman Bros., Limited, are now engaged in the construction of an entirely new oil engine, embodying improvements and so designed as to make the cost of production as low as possible. The directors can but hope that the efforts of Messrs. Priestman Bros., Limited, may result in a larger turnover, and that their business under better auspices may be materially increased. The balance standing to the credit of the income and expenditure account, after allowing for the deficiency of £89 14s. 3d., in respect of the year under review, is £2 16s. 5d., which the directors recommend to be carried forward.

British Westinghouse Electric and Manufacturing Company.

The second annual meeting of this company was held at Cannon Street Hotel on Monday, Mr. George Westinghouse presiding.

The Chairman, in moving the adoption of the report, said that the profits so far were all that the most sanguine could expect. He proceeded to summarise the history of the company, then to deal with the accounts and give a description of the works, and, finally, to describe the field of electrical engineering, in so far as it offers the opportunity of making money for the company. In the business of manufacturing electrical machinery and appliances, America got ahead of England. Partly owing to the prevailing spirit of enterprise in younger communities, partly because of greater freedom from imperial and municipal interference, the demand for electrical power and for machinery to produce and utilise it, began to come fifteen years ago from cities great and small all over the United States. He did not mean power merely for lighting purposes—that was a little thing comparatively—he meant for production of all sorts, and for cheaper, quicker, and cleaner means of communication in big towns and suburbs. Such power is money. England was now ten years later than America, getting some idea of what "electrical transit" meant in London by means of the tube railway, and as to the economy of production of staple articles he could not quote more forcible testimony than that of the Carnegie steel works. In 1892 they applied to the Westinghouse Company to put in electrical machinery and labour-saving appliances. They had been adding to that machinery ever since, and their competitors all over the world found that they had got to do the same. Great English manufacturers, railways, and municipalities are now alive to this. The Westinghouse Electric and Manufacturing Company, of Pittsburg, had grown up from small beginnings through good and bad times alike, till it now has works employing 9,000 men and a capital of over £4,000,000 sterling, consisting mostly of preference and ordinary shares like the British company. It was paying 7 per cent. dividends upon both classes of shares, and accumulated reserves besides. As to the cause which led to the formation of the British company, it would obviously be more economical to manufacture at Manchester the electrical plant required, *e.g.*, for the Mersey Railway, than to incur the cost of shipping it all the way from Pittsburg. In July, 1899, the American company sold its British business (including patents and plans which had cost a very large sum) for ordinary shares in the British Company. Those who were 6 per cent. preference shareholders might have the satisfaction of feeling that the American Westinghouse Company had put in the whole of its interest behind theirs. It could get no return upon its outlay till they had had 6 per cent. on their money represented by preference shares. Further, after 6 per cent. was paid upon the ordinary shares, they, as preference shareholders, became entitled to one-fourth of the profits remaining available for dividend. The profits in excess of the preference dividend already amounted to something considerable, but were carried forward for the present. After briefly referring to the gas engine business, Mr. Westinghouse said that as to the profits, of course, until the Manchester works were open, orders would have to be executed as heretofore at Pittsburg. In other words, the British Company only got a portion of the manufacturing profit. As soon as the Manchester works are running they would get the whole profit, whatever it might amount to. They would be well satisfied with the net result for the past year, viz., £40,533, which was arrived at after liberal deductions from the gross profits for writing down the three accounts enumerated in the balance-sheet, viz.—(1) the stock on hand, (2) the laboratory fittings, tools, &c., and (3) the expenditure on development, exhibitions, &c; besides, their expenses were much larger at starting, in proportion to capital, than they would be when the works are running and they are all earned and paid for. The 6 per cent. dividend in the preference shares, as paid up, required £30,625, and after paying it there was still £18,908 surplus to carry forward. The orders on hand showed a steady growth from £270,000 in July, 1899, to £738,000 in July, 1901. Among the orders, one of the more important is the contract for electrifying the Mersey Railway. This, when completed, will be another object lesson in the North, like the Tube in London, as to the speed and cleanliness of underground lines in big cities worked by electricity. It happened that the Mersey Railway Company required to pay for its electrification in debenture stock, as authorised under its Act of Parliament, instead of in cash, and according to their experience in America, the same was often the case. It is not the business of the company to take payment in anything but cash; so to meet that and other such cases, they had formed the Traction and Power Securities Company, Limited, with a nominal capital of £1,000,000, to handle such securities and give this company cash for its machinery. The company had taken an interest in this concern, and already more than enough had been subscribed independently to the shares of the Traction and Power Securities Company to deal with the case of the Mersey Railway, and relieve the B.W. Company. If any shareholders desired to be interested in the shares of the Traction and Power Securities Company, they could obtain particulars from the secretary. He then gave a brief description of the works, upon which they had spent up to July 31st £433,126, exclusive of the land. It is expected that manufacturing operations at Manchester will begin early in 1902. The excellent arrangements which are proceeding for the erection of workmen's and foremen's cottages were mentioned, also the other directions in which careful attention is being given to securing the health and happiness of the employés—an essential condition for business success. The Manchester works will be devoted to the manufacture of the well-known types of Westinghouse electrical apparatus for lighting, power and traction, by alternating and direct current, including generators, rotary converters, stationary and tramway motors, transformers, switchboards, and auxiliary apparatus. A considerable portion of the works will be devoted entirely to the manufacture of gas and steam engines The company's works manager, Mr. H. S. Loud, has, with a competent staff of assistants and with the aid of the officers and engineers at Pittsburg, prepared plans and selected the machine tools

required for the conduct of the business on a large scale, and is at the present time at Pittsburg, with a force of mechanics, engaged in the preparation of special machines, patterns, jigs and templates in a portion of the works of the American company which has been set aside for the purpose. The company's field was the British Empire, with the exception of Canada, which can be supplied more economically from Pittsburg. Westinghouse Companies are established also in France, Germany and Russia; each company dealing with its own field, but with agreements providing for mutual co-operation. This made a very strong combination for exchange of engineering information, for securing valuable patents that might turn up anywhere, and for mutual assistance throughout the world. In regard to the future of electrical engineering, the next 10 years will witness great developments. If railways want to protect the properties they have built up, they have got to take the initiative, and handle their suburban traffic by electricity instead of sitting still and seeing competing companies started to cut into them. The question for old-fashioned steam railways was—what to do? Something they had got to do.

Mr. Joseph Lawrence, M.P., seconded the motion, and it was carried unanimously.

A vote of thanks to the executive committee and staff for their services during the past year was passed, as was also a resolution increasing the remuneration of the auditors to 300 guineas for this year and last.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—Edmundson's Electricity Corporation, Limited—10,000 ordinary shares of £5 each (issued at 5s. premium), £3 5s. paid (of which £3 is capital and 5s. premium), and to appoint a special settling day in—Edmundson's Electricity Corporation, Limited—Further issue of 10,000 6 per cent. cumulative preference shares of £5 each (issued at 5s. premium), £3 5s. paid (of which £3 is capital and 5s. premium). The Committee has ordered the undermentioned securities to be quoted in the Official List:—British Westinghouse Electric and Manufacturing Company, Limited—Further issue of 50,000 6 per cent. preference shares of £5 each, fully paid, Nos. 100,001 to 150,000. Calcutta Electric Supply Corporation, Limited—Further issue of 10,000 shares of £5 each, fully paid, Nos. 20,001 to 30,000.

Prospectus.—Yesterday the list of applications closed in an issue of 15,000 6 per cent. £10 cumulative preference shares (at £11 per share) by the Electrical Power Distribution Company. The subscription of the issue was guaranteed by the B.E.T. Company and the Brush Company, and their expenses of the issue are met by their receiving the £1 per share premium; but the rights and liabilities of these two companies have been transferred to J. S. Morgan & Co. and the Electric and General Investment Company.

Richard Hornsby & Sons.—The directors recommend a dividend of 6s. per share on the ordinary shares for the year ended September 30th, placing £5,000 to reserve, and carrying forward £1,283.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Nov. 22nd were £469; corresponding week last year, £412: increase, £57. Total to date, £23,722; corresponding period last year, £21,057, increase, £2,665. Miles of track open, 8¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending November 23rd were £187; corresponding week last year, £162; increase, £25. Total receipts to date, £20,186; corresponding period last year, £19,576; increase, £610.

Bristol Tramways and Carriage Company.—The receipts for the week ending November 22nd were £3,626; corresponding period last year, £2,704; increase, £922.

Central London Railway.—The receipts for the week ending Nov. 23rd were £6,649; corresponding week last year, £5,755; increase, £894. Total receipts from July 1st (21 weeks), £127,433. Miles open, 6.

City and South London Railway.—The receipts for the week ending Nov. 24th were £3,029; corresponding week last year, £1,849; increase, £1,180. Total from July 1st to date, £42,675; corresponding period last year, £33,957; increase, £8,718. Miles open, 6¼; corresponding period last year, 4¾.

Dover Corporation Tramways.—The receipts for the week ending November 23rd were £173 2s. 3½d.; corresponding week last year, £162 12s. 2½d.; increase, £10 10s. 1d. Total to date, £10,286 15s. 3½d.; corresponding period last year, £9,762 15s. 10d.; increase, £523 19s. 5½d. Miles of track open, 8; Car miles run, 1901, 5,372; 1900, 4,977. Number of cars, 1901, 12; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending November 22nd were as follows:—D.U.T. Co., electric cars, £3,258 10s. 1d.; D.S.D. Co., electric cars, £680 19s. 10d.; total, £3,939 9s. 11d.; corresponding period last year—D.U.T. Co., electric cars, £3,127 19s. 2d.; ditto, horse cars, £22 12s. 6d.; D.S.D. Co., electric cars, £684 10s. 10d.; total, £3,835 2s. 6d.; increase, £104 7s. 5d.; aggregate to date, £99,704 5s.; aggregate to date last year, £98,559 5s. 8d.; increase, £1,144 19s. 4d. The mileage worked is 45 miles electrically, as against 43 miles electrically, and two miles by horses, for the corresponding period last year.

Glasgow Corporation Trams.—For the week ending November 16th, 1901, £10,446 7s. 5d.. compared with £9,057 2s. 6d. for corresponding week last year, and £18,705 for the preceding week, which was the last week of the International Exhibition.

Liverpool Overhead Railway.—The receipts for the week ending Nov. 24th were £1,434; corresponding week last year, £1,525; decrease, £91. Total from July 1st to date, £33 550; corresponding period last year, £35,074 decrease £1,524. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The money market dominates the situation to a large extent, and although there is a plentiful supply of loanable cash, the Stock Exchange has to pay stiffer rates for it at the current settlement than was expected last week. Bankers wanted 4 to 4½ per cent. for fortnightly loans, and they got it. This has had an evil effect upon general business, which has also to bear the brunt of the usual anticipatory fears as to a further end-of-the-year money squeeze. But while these conditions are depressing markets as a whole, the Electrical Supply section is well supplied with orders. It is, of course, the regular rule for this department to make its financial hay in the dark days, and if business does not develop during the winter months, it is a poor look-out for the jobbers. Telegraph descriptions are more affected by the hardening money market, and beyond the National Telephone excitement, the miscellaneous department remains respectably dull.

City and South London, Waterloo and City, and Central London stocks are virtually unchanged. The tragic accident on the Twopenny Tube last Monday evoked considerable sympathy in the Stock Exchange, the deceased being a gentleman well known in the City, although he was not a member of the "House," as several papers erroneously stated that he was. City and South London stock finds buyers over 60, and the shares can be sold at 5⅝. Baker Street and Waterloo are called £6 discount. Great Northern and City Preferred are freely changing hands in the neighbourhood of 8½, and some of the Stock Exchange dealers are establishing a special "branch" for business in electrical railway securities. London-Brighton "A" stock is suffering severely, after its temporary fillip of last week, from the prospects of competition by the proposed electric line from London to Brighton. Animated discussions are raging in Brighton, as well as in London, as to the likelihood of Parliamentary powers being given to the new comer, seeing that the original company is also contemplating electric traction.

In the electricity supply section the advances and declines are pretty evenly balanced. The prices of Notting Hill shares and St. James's have crossed each other, the latter now being 10s., the higher of the two. South London Ordinary are weak at 2¼, and "City Lights" are down half a sovereign, the inside crowd having turned sellers this week. Chelseas, on the other hand, are harder, and so are Brompton Ordinary, the go-ahead policy of the Brompton Company commending the shares to a certain circle of supporters. In the pre-Ordinary list, the only change is a point rise in County of London 4½ per cent. Debenture stock. Notting Hill new shares hardened after the application had been sent in, and are now quoted 2 to 2½ premium. Some weakness is observable in Brush issues, despite the quotations remaining nominally unchanged, and it is said that shareholders do not like the resignation of Mr. Braithwaite from the board.

The Electrical Power Distribution issue of 15,000 6 per cent. cumulative Preference shares of £10 each at £11 per share appeals to a small and select body of investors, and it is only natural that no market should have been made in the new emission. One ardent prophet in the market professes that he can already foresee the time when this company and the British Electric Traction will link hands in amalgamation. The shares of the Traction Company are a shade harder on the week. New General Traction Ordinary are 3, and the Preference 4½; both are £5 shares. Business is looking up in Brisbane Electric Tramway shares, and both Ordinary and Preference are the same prices as those of the New General Traction Company. Blackpool and Fleetwood are 13½; Belfast, Calcutta, and Dublin United all remain at £12 middle. North Metropolitans, on electrification prospects, are hardening a shade, and the price is about 4⅜. London United Tramways Debenture stock is 105, the new issue being quoted at 3 premium, while the new Preferences are better at £1 premium. Those who are sure of an allotment of the last named cannot hurt by taking their profit.

The Telegraph Market is very quiet. None of the Anglo-American prices are noticeably changed, but Anglo "B" stock is rather on offer. Commercial Cable has recovered to its former wide quotation, but they are talking of a slackening of the Yankee boom in the Stock Exchange, and should that come about, there will probably be some set back in the cable companies' quotations. Western Telegraphs have shed the fraction which they annexed last week, but United River Plate Telephone shares, by ¼ rise this week, have pulled themselves just over par.

National Telephone varieties are merely marking time amidst the changing of chairmanship, County Council onslaughts, and vigorous criticism that is going on. The shares are 4¼ buyers, and the 4 per cent. Debenture stock can hardly be bought at all, so scarce is it in the market. Judging from some of the lamentations now appearing, it might be supposed that National Telephone shareholders were ill-advised to retain their investments for another day. But we rather fancy that the next speculative wave will carry the price of the Ordinary shares to 5 at least.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotations Nov. 20th.	Closing Quotation Nov. 27th.	Business done during week ended Nov. 27th. 1901. Highest.	Lowest
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	98 —101	98 —101	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3⅛— 4½	3⅛— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	78 — 83	78 — 83	...	...
804,720	Anglo-American Telegraph	Stock	£3 9s.	7s/6	3⅛%	52 — 55	52 — 55	...	...
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	98 —100	98 —100	99	98½
3,097,640	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	9½— 10	9½— 10	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	5 %	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	180 —185	180 —190	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	100 —102	102	...
16,000	Cuba Telegraph	10	8 %	7 %	...	5 — 6	5 — 6	5⅜	5
6,000	Do. 10 % Pref.	10	10 %	...	...	13½— 14½	13½— 14½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½ — 9½	8½ — 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104 %	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10½— 11½	10½— 11½	10⅝	...
104,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	137 —141	137 —141	140	138
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	93 — 96	93 — 96	95	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	112 —115 xd	112 —115	113½	112¼
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13⅜— 14¼	13⅜— 14¼	14½	14
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	113 —118	113 —118	115	114
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	5¼%	...	100 —103	100 —103	101	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103	100 —103	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	5½%	11¼— 11⅜	11¼— 11⅜	11 9/16	11⅜
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14⅜— 15½	14⅜ — 15½	14⅜	...
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	30 — 32	30 — 32	...	...
78,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	40 — 44	40 — 44	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	102 —105	102 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼— ¼ xd	¼— ¼	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅞— 1 xd	¾— 1	...	..
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	4½— 4⅝xd	4⅝— 4⅝	4¼	4 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	12½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	4 1/16	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 99	95 — 98	...	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	...	4 %	99 —102	99 — 102	100⅛	100⅛
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	5/16— 1 1/16	5/16— 1 1/16	...	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	126½	...
58,000	United River Plate Telephone	5	6 %	7 %	...	4⅜— 5¼	5 — 5½	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅜— 5¼	4⅜— 5¼	4 1/16	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	99 —102	99 —102	...	..
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	14½— 15	14½— 14⅝	14⅝	14¼
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	103 —106	103 —106	..	
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	103 —106	103 —106	105	104½
88,321	West India and Panama Telegraph	10	2 %	5%	...	⅜— ⅝	⅜— ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5½— 6½	5½— 6½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 5	3 — 5	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104	101 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅜— ⅝	⅜ — ⅝	...	...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	97 — 102	97 —102	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅜— 8¼	8 — 8½	8½	8 3/16
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8¼— 8⅜	8¼— 8⅜	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	...	...
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅜	5¼— 5⅜	5 7/16	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	105 —107	105 —107	106½	106
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5 — 5½	5¼— 5⅜	...	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	111½	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	9½— 10½	9 — 10	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	11½— 12½	11½ — 12½	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	102 —105	102 —105	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	12	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	104 —107	105 —108	106½	106¼
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5½— 6	5½— 6	5⅞	5¾
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½— 6	5½— 6	5⅞	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	105 —108	105 —108	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	11 9/16	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	3½— 4½	3½— 4½	4⅛	3⅞
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	...	..
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13½— 14½	13½— 14½	14 3/16	13⅞
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	113 —116	113 —116	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	96 — 99	98½	...
8,652	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½— 16½	15 — 16	..	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15½— 16½	15⅝	15⅝
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100	97 —100	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2¼— 2⅜	¥2 — 2½	...	...
109,518	Westminster Electric Supply, Ord.	5	12 %	13 %	10½%	11½— 12½	‖11½— 12½	12 7/16	12

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ¥ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Nov. 20th.	Closing Quotation Nov. 27th.	Business done week ended Nov. 27th, 1901. Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	£10	...	...	...	5 — 6	5 — 6	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	87 — 91	87 — 91	...	...
62,074	British Electric Traction	£10	6 %	8 %	9 %	13½ — 14½	14 — 14½	14 7/16	14½
90,000	Do. do. 6 % Cum. Pref.	£10	...	...	...	11⅜ — 12¼	11⅜ — 12¼	12⅛	12 1/16
600,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	121 —124	121 —124	123	122½
70,000	British Insulated Wire Ord.	£5	15 %	20 %	15 %	8 — 9	8 — 9	...	...
70,000	Do. do. 6 % Cum. Pref.	£5	...	...	...	5½ — 5¾	5½ — 5¾	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	...	8 %	⅞ — 1	⅞ — 1	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	...	6 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16 xd	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	£2	4 %	5½ %	5 %	1⅝ — 1⅞	1⅝ — 1⅞	2	1⅝
150,000	Do. do. Non-cum. 6 % Pref.	£2	6 %	6 %	6 %	1⅞ — 2⅛	1⅞ — 2⅛	2	1⅞
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	104¼	103½
125,000*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102	99 —102	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	£5	15 %	15 %	15 %	16 — 17	16 — 17	16 13/16	16½
40,000	Do. do. 5 % Cum. Pref.	£5	...	...	...	5½ — 6	5½ — 6	5½	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	112 —116	112 —116	110	109
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	...	108 —111	107 —110	110¼	107⅜
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	...	105 —108	105 —108	108	107¼
440,100	Do. do. Def. do.	Stock	...	...	...	107 —110	107 —110	108½	107¼
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1¼%	59 — 62	60 — 63	61⅛	60
47,500	Do. do. Ord. shares Nos. 22,501 to 70,000	£10	...	...	...	5½ — 6	5½ — 6	5⅝	...
54,000	Crompton & Co., Nos. 1 to 54,000	£3	6 %	7½%	8 %	3 — 3½	3 — 3½	3 7/16	3⅜
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —105	100 —105	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	£5	6 %	6 %	2½%	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	£5	6 %	6 %	2½%	1½ — 2½	1½ — 2½	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	£100	...	...	...	80 — 85	80 — 85	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	£100	...	...	...	84 — 89	84 — 89	...	...
112,100	Electric Construction, 1 to 112,100	£2	6 %	6 %	6 %	1⅞ — 2¼	1⅞ — 2¼	2⅜	2 1/16
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	£2	7 %	...	...	2½ — 3	2½ — 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 —102	98 —102	101	100½
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	£10	...	...	...	10 — 10½	10 — 10½	10½	10 5/16
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 — 102	99 —102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	£5	14 %	15 %	20 %	16½ — 17	16 — 17	16¾	16½
35,000	Do. do. do. 4½ % Pref.	£5	...	4½%	4½%	5½ — 6	5½ — 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	112 —116	112 —116	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	£10	10 %	10 %	...	23 — 24	23 — 24	23⅝	23½
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	£100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	£10	3½%	3⅝%	3½%	5⅞ — 6⅛	5⅞ — 6⅛	...	...
10,000	† Do. do. Pref., £10 paid	£10	5 %	5	...	12½ — 12⅝	12 — 12½	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	£10	...	...	...	15½—16½	15½ — 16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	£12	15 %	15 %	17½%	38 — 42	38 — 42	40½	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	£100	...	...	...	104 —106	104 —106	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	£5	8 %	12 %	12 %	10½ — 11½	10½ — 11½	11⅛	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	£5	...	...	...	5½ — 6	5½ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	£100	3 %	3 %	3 %	91 — 94	91 — 94	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 2/—4/-
National Electric Free Wiring, 17/6 paid, ½—¾.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10⅞—10¾.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (October 31st, 1901).

MARKET QUOTATIONS, Wednesday, November 27th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a „ „ ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£22	£22	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a „ Caustic (75/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£25	£25	..
a Shellac	per cwt.	135/-	135/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£8	£8	..
a „ Bichromate, casks ..	per lb.	2½d.	2½d.	..
METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots..	per ton	£75 to £125	£75 to £125	..
c Brass (rolled metal 7" to 12") basis	per lb.	7¾d.	7¾d.	..
c Tube (brassed)	per lb.	9¼d.	9¼d.	..
c „ „ (solid drawn) ..	per lb.	8¼d.	8¼d.	..
c „ Wire, basis	per lb.	7¾d.	7¾d.	..
c Copper Tubes (brassed) ..	per lb.	10d.	10d.	..
c „ „ (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£80	£80	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£80	£80	..
g „ Rod	per ton	£80	£80	..
c „ (Electrolytic) Bars ..	per ton	£82	£82	..
c „ „ Sheets ..	per ton	£90	£90	..
c „ „ Rod ..	per ton	£84	£84	..
c „ „ H.C. Wire	per lb.	9½d.	9½d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
m German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/5½ to 3/7½	3/4 to 3/6½	inc.
t Iron, Charcoal Sheets	per ton	£18	£18	..
t „ Pig (Cleveland warrants) ..	per ton	43/5	43/6	1d. dec.
t „ Forgings, according to size	per ton	From £11	From £11	..
t „ Scrap, heavy	per ton	50/- to 52/6	50/- to 52/6	..
t „ Wire, galvanised No. 8 ..	per ton	£10	£10	..
g Lead, English Ingot	per ton	£11 7 6 to £11 10	£11 10 to £11 12 6	2/6 dec.
g „ Sheet	per ton	£13 10	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 17 6	£8 17 6	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ „ strip & sheet	per lb.	From 1/8	From 1/8	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
t Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
t „ „ in bars		£58	£58	..
g Tin, block	per ton	£120 to £121	£115 to £116	£5 inc.
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 16	per lb.	1/7	1/7	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
f Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
f „ 6 lea. Flax	per lb.	5½d.	5½d.	..
f „ 3 ply 10 lbs. Russian ..	per lb.	4¼d.	4¼d.	..
f „ 10 lbs Russian, single ..	per lb.	4¾d.	4¼d.	..
f „ 180 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
s Zinc, Sh's. (Vieille Montagne and.)	per ton	£22 10	£22 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Jackson & Till. t Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co.

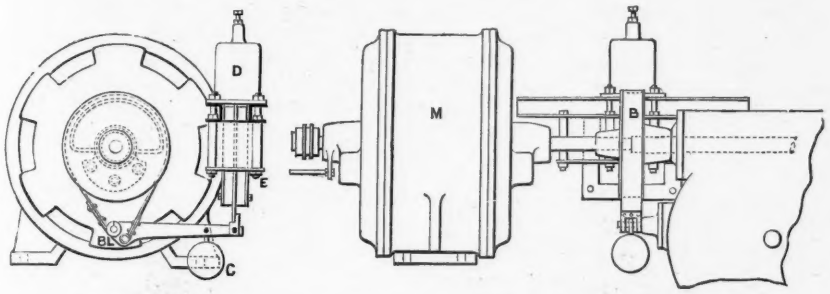
Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

ELECTRIC EQUIPMENT OF CRANES.

By WILL RUNG, of Baden, Switzerland. Translated by W. PARK and J. LEHMANN.

(*Concluded from page* 622.)

The Brake.—The electric brake action, produced when a running motor is allowed to produce energy as a dynamo, does not always bring the armature to a standstill. If braking is attempted after the speed has fallen below a certain limit, the E.M.F. of the motor is so small that the braking effect is likely not to be called into existence at all, and of course this method does not enable the load to be maintained in any given position. For this reason the mechanical friction brake must as a rule be added. The ordinary block or band brakes are both suitable for this purpose, as they may be easily worked automatically. Fig. 7 shows such an automatic brake for a three-phase motor. An electro-magnet, connected up in parallel to the motor, lifts the counter-weight of the brake at the very moment of starting the motor; when the current is switched off the counter-weight is at once released, and the brake thus being brought suddenly into action, the motor stops almost instantly. When direct current is used for the motor the magnet operating the brake usually consists of a solenoid with an iron plunger. It has not been found so easy to devise an automatic brake operated by alternating current, and great difficulties had to be overcome before a thoroughly satisfactory construction was arrived at. Often a small motor is employed having fixed to its shaft an eccentric, which lifts the counter-weight; this type is still used by some makers, although involving several drawbacks, not the least important one being a large consumption of current. Better results have been obtained by providing electro-magnets similar to those used in the case of direct current, but their very noisy way of acting was found to seriously interfere with the issuing of verbal directions between the crane man and other members of the staff. The firm of Brown, Boveri & Co. has recently succeeded in constructing an electro-magnet for polyphase alternating current, which is in every respect satisfactory; its action is absolutely reliable and noiseless, and it uses very little current. In order to steady the stroke of the movable iron core, this is provided with a dash-pot.



D, Dashpot; E, Electromagnet; B L, Brake lever; C, Counterweight for brake; M, Motor; B, Brake.

FIG. 7.

Lately a novel electric brake has made its appearance which has no rubbing surface. It consists in an iron or copper disc mounted on the speediest shaft and rotating in a magnetic field, the current produced in the disc retarding the shaft. These brakes, however, suffer from the same drawback as followed the use of the motor itself as a brake, namely, that their action ceases as soon as the speed has fallen below a certain limit.

General Arrangement of supply mains, motors, and controlling gear, &c. The current is supplied to the motor in the simplest possible manner, a circumstance which has greatly influenced the advancement of electric cranes. The principle is mainly the same as used on electric tramways with overhead conductors, but the relatively small speed of the crane allows of greater simplicity than is possible on a tramway system. The crane is supplied through contact wires stretched along the wall—two if direct current, three if three-phase current—from which the current is led through insulated sliding contact pieces or trolleys to the crane, where it passes a main switch and fuses, before it enters the starting apparatus. From this the current reaches the different motors and electro-magnets partly through bare contact wires and partly through insulated cables.

Fig. 8 represents a travelling crane for three-phase current and having a lifting power of 25 tons. The whole equipment with leads, motors and apparatus will be readily understood from the drawing. From the leads extending along the room the current passes by the trolley wheels through insulated cables to the driver's platform, where it is distributed to the three starting switches, namely, W_H for the lifting motor M_H;

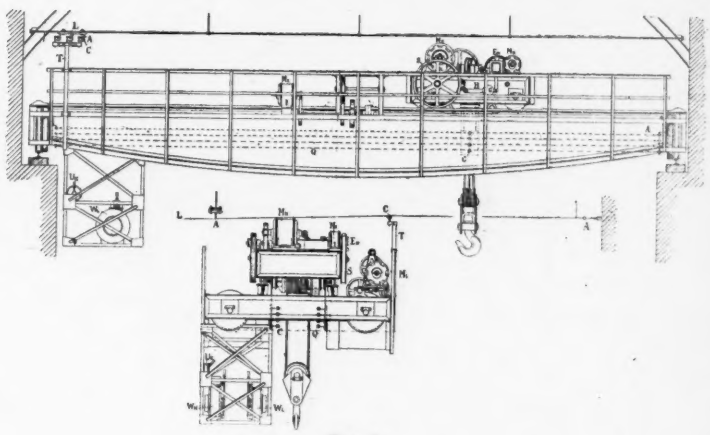


FIG. 8.

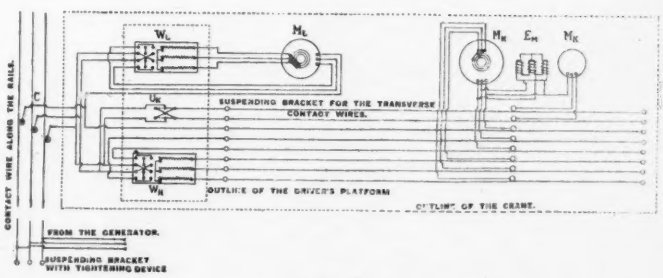

CONTACT WIRE ALONG THE RAILS.
FROM THE GENERATOR.
SUSPENDING BRACKET WITH TIGHTENING DEVICE
SUSPENDING BRACKET FOR THE TRANSVERSE CONTACT WIRES.
OUTLINE OF THE DRIVER'S PLATFORM
OUTLINE OF THE CRANE.

FIG. 9.

W_L for the motor M_L giving the longitudinal motion; and the reversing switch U_K for the motor M_K moving the crab transversely. The motor M_K has a squirrel cage armature, and thus no starting resistance is provided. Both of the motors M_K and M_H being placed on the crab itself, eight contact wires, Q, are required for the supply, extending along the crane girders, and from these the current goes through as many insulated contact rolls, C. The lifting motor is provided with a friction brake, controlled by

the electro-magnet, E_M. The connections are shown in fig. 9.

The most convenient arrangement possible is that shown at fig. 8, where the motor for moving the crab aside, as well as that for lifting the load, is carried by the crab, which thus moves by virtue of its adhesion to the rails. From time to time another arrangement is met with, by which the crab-moving motor is placed upon one of the ends of the crane girders, the crab being moved by means of a wire rope or chain; this arrangement, however, although rendering the design of the crab simple and light, and allowing of greater simplicity of the electric connections, cannot be said to be satisfactory, involving as it does several drawbacks. The wire rope, for instance, which is usually preferable to the chain owing to its greater flexibility and lightness, requires constant inspection and frequent tightening up, and, moreover, its elasticity hinders the exact adjustment of the crab over the load to be lifted.

down by itself when the brake is released and the motor disconnected. As by this arrangement the motor will never run entirely unloaded nor as a dynamo, a series motor can be used for the hoisting gear; this motor presenting, as above mentioned, important advantages over the shunt motor otherwise necessary.

When a travelling crane is required to be very delicately adjustable, as, for instance, when used for erecting purposes, or for lifting patterns out of the moulds in foundries, all the motors must be provided with one or other of the brakes described above.

The starting switches, the automatic cut-outs and a main switch are placed on a special platform, from which they are manipulated. This platform is preferably supported on the crane itself, and in such a position that the driver may at any moment have a free outlook upon the entire crane and upon the material to be transported. To place the driver outside the crane so that he does not move with it, will

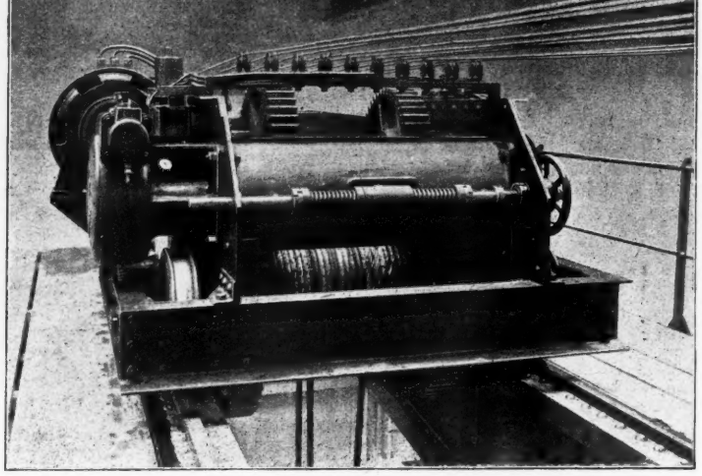


Fig. 10.

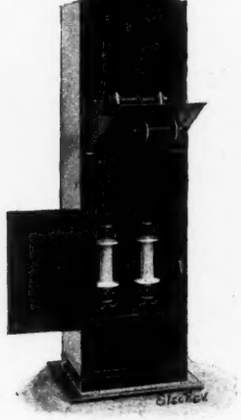


Fig. 11.

Fig. 10 represents the crab of a crane worked by three-phase current and designed for loads up to 15 tons weight.

The motor for running the crane along the room is most conveniently placed on the centre of one of the girders, and its shaft is prolonged to the very ends of the girders, where it is connected through some gear or other to the supporting wheels of the crane. To place the motor at one of the girder ends, although affording a slight saving of leads, is not advisable, as the elasticity of a long shaft renders it possible to twist the entire crane relatively to the rails, when starting and stopping.

As a rule the shaft of any of the motors is connected to the wheel gear by means of a mechanical clutch, which must possess some elasticity in order to protect the motor shaft against too sudden torque. The gear may be spur-wheel or worm-wheel gear. Nowadays, when slow speed motors are extensively constructed, the wheel gear is preferable owing to its higher efficiency. Certainly the worm-wheel gear has the advantage of not being reversible, provided a suitable slope of the threads is used on the worm, so that the load is thus prevented from descending accidentally. Usually, however, as the speed required is fairly high, this advantage can only be obtained at the expense of efficiency. Thus it becomes necessary in most cases to provide some form of electro-mechanical brake to maintain the load in a given position.

In the case of big swing cranes in harbours and other places it has proved very satisfactory, especially when using direct current, to disconnect the motors entirely from the gear when lowering a load and allow the load to descend by its own weight. In such a case the speed is controlled by a mechanical brake having its lever connected to the starting resistance handle. The hook is made heavy enough to run

usually prove an inconvenient arrangement, complicating the cables and preventing the driver from minutely following the movement of the crane.

In the case of small travelling cranes all the regulating and starting devices have successfully been fitted to the crab, enabling the crane to be worked from below by means of ropes or chains. The need of a special man for driving the crane is thus dispensed with, and any workman may use the crane without having to communicate with the driver by shouting or gesticulating. Further, the workman being close to the material to be dealt with, the most delicate possible adjustment of the crane relatively to the load is easily obtained. If the crane be controlled from above, but no special driver be employed for manipulating it, the switches should be easily handled and the controller levers should move in the same direction as the resultant motion of the load.

Lately a further simplification has been introduced, two of the switches being so coupled together as to be served from a single handle, which is movable in any direction. When moved in a vertical plane, only the lifting motor starts and thus the load is raised, whereas when moved in a horizontal plane the traversing motor only is started, the load being thus moved sideways. When moved in a certain oblique direction, both of the motors are started, so that the load moves in an oblique direction parallel to that in which the handle is moved. Thus the driver has no more than two handles to serve, one for each hand, namely, the universal handle for hoisting and traversing, and another for longitudinal movement of the entire crane.

This arrangement has been frequently adopted, particularly in Germany; but opinions differ as to whether its use really facilitates the manipulation of the crane.

To prevent accidents, any fairly fast running travelling crane should be fitted with automatic cut-outs, coming into action if the entire crane, or its crab or hook, should try to move beyond a certain position. The firm of Brown, Boveri & Co. has lately constructed such cut-outs, which have been found most reliable, and afford a very high degree of safety, not only to the crane, but also to the staff. They are so designed as to absolutely exclude the possibility of any movement taking place beyond a certain position at which the cut-out comes into action, even if the driver should try to remake the circuit by hand. However, the back movement can take place by merely reversing the motor. As soon as this has been effected the cut-out closes the current again automatically, and everything is once more in the normal condition. These devices are of simple design, and can be fitted on any part of the crane.

To enable the whole of the equipment to be entirely cut off from the supply mains, a special main switch is arranged together with fuses and an ammeter on a small marble slab fixed to the wall, or in a special distribution pillar, of which fig. 11 gives a view as used for 500—1,000 volts.

The above remarks, although condensed, will clearly show that the electric operation of cranes has reached a state of great perfection, and the day cannot be very far distant when, thanks to its simplicity of working, the electrically-worked crane will have entirely swept away all other systems of cranes now worked by steam, hydraulic, or any other purely mechanical power.

APPLICATIONS FOR PARLIAMENTARY POWERS, SESSION 1901—2.

The following is a part summary of the applications which are being lodged at the present moment with the Board of Trade and Parliament for electric lighting, power, tramway and railway powers. The full notices will be found in the *London Gazette* for November 19th and 22nd. We shall publish the concluding portion next week.

Electric Lighting.

London (Board of Trade measure for altering and adjusting areas); Hindhead and District (John Grover, of Finsbury Park, London); Springhead (U.D.C.); Otley (U.D.C.); Wadhurst Gas Company (powers as to electricity); Tipton (U.D.C.); Birkenhead (wiring of premises, alteration of charges, extension of time, &c.); Stanley (U.D.C.); Wood Green (U.D.C.); Slough (U.D.C.); Newcastle-upon-Tyne Electric Supply Company (additional powers for parts of County of Northumberland); Leyland (U.D.C.); Tadcaster and District (Tadcaster Electricity Company, Limited); Chard Gas and Coke Company (electric lighting powers); Bournemouth (Corporation); Finchley (supply of energy in bulk outside district, supply of fittings, extension of time, prohibition of overhead wires); Huddersfield (supply of electric fittings); Abertillery (U.D.C., supply in bulk outside district, and electric fittings); Ardsley East and West (U.D.C.); Gillingham (provisional order, purchase of undertaking of Chatham, Rochester and District Electric Lighting Company); London County Council (purchase of electric lighting undertakings in the County of London); Beeston (U.D.C.); Blaydon (U.D.C.); Chester-le-Street (County of Durham Electrical Power Distribution Company, Limited); Eston (U.D.C.); Enfield (North Metropolitan Electric Power Distribution Company); Dartford (U.D.C., supply in bulk outside district, and electric fittings); L.C.C. (general powers, powers to Borough Councils to make agreements for wiring and fitting premises for use of electricity; scheme of municipal insurance); Bristol (supply of wiring and fittings, postponement of sinking funds for electric light loans); Liverpool (Corporation, supply of energy to premises having separate supply); Cowes (Isle of Wight Electric Light and Power Company); Carnarvon (Corporation); Saddleworth (U.D.C.); Eastbourne (supply of fittings, &c.); Pokesdown (Bournemouth and Poole Electricity Supply Company); Penarth (amendment of order as to terms of purchase by local authority); Lower Bebington (U.D.C.); Abram (U.D.C.).

Tramways and Light Railways.

Glamorgan County Council (Morriston to Pontardawe light railways); Doncaster Corporation (light railways); Preston Corporation (new trams); Cheltenham and District (C. and D. Light Railways Company); Halifax Corporation (various tramway powers); Tipton U.D.C. (to work trams when acquired, also supply electricity and fittings outside district); Sunderland Corporation (new trams); Mexborough and Swinton (a company; tramway and electric lighting powers, supply of electricity in bulk to other companies and bodies); Stockport Corporation (tramways); Southampton Corporation (tramways provisional order); Brighton Corporation (provisional order); Newport, Mon. (tramways); West Ham (new lines amendment of Act of 1900 as to tramways and street widenings); North Metropolitan Tramways Company (use of electric traction); Erdington (new trams, supply of electrical fittings, supply of electricity in bulk outside district); Rhondda (U.D.C.); North Ormsby, South Bank and Grangetown (new company); Devonport Corporation (sundry powers); L.C.C. (subways and tramways, Theobald's Road to Victoria Embankment); Aberdare (U.D.C.); Newcastle-upon-Tyne (Corporation extensions); Northumberland (Northern Counties Electricity Supply Company, Limited; tramways from Morpeth to Bedlington, Bebside to Blythe and Ashington to Newbiggin; obtaining supply of electricity in bulk from other parties); L.C.C. (tramways and improvements, sundry new tramways); Romford (U.D.C); South Shields (Corporation); Birmingham and Midland (B. and M. Tramways, Limited); Bradford (Corporation new tramways in Bradford and Shelf); Manchester (Corporation, new lines, purchase of Salford lines, running powers in Salford, &c.); Wigan (purchase of company's system, new tramways, &c.); North Staffordshire (North Staffordshire Tramways Company and Potteries Electric Traction Company); York (Corporation purchase and electrical working, further electric lighting powers within and without the city); Nottingham (Corporation, tramways, supply of electricity within and beyond the city); Tyneside Tramways and Tramroads Company (new lines and extensions); North Shields, Tynemouth and district (extensions Tynemouth and District Electric Traction Company); Leicester (various tramway powers); Southport and Lytham Tramroad Company (extensions of time); Poole and District Light Railway (extension Poole and District Electric Traction Company); Middlesex (County Council); Birmingham (Corporation, construction and working of tramways electrically); County of Middlesex Light Railways (Enfield extensions).

Underground and other Railways.

Great Northern Railway (No. 2, construction of railway, partly underground, and powers to lease it to the Great Northern and City Railway); North and South Shields Electric Railway (underground, new company, supply of electricity, agreements with Tynemouth and South Shields Corporations and Electric Supply Companies); Great Northern and City Railway Company (extension of railway to Lothbury, new subway, stations, &c., extension of time and enlargement of tunnels for station purposes, &c.); City and North-East Suburban Electric Railway (No. 2, construction of railway in part substitution for those mentioned in the 1901 Bill suspended, and other lines); Charing Cross, Euston and Hampstead Railway (No. 3, extension to Charing Cross, station of Metropolitan District Railway, and other powers); Great Northern and Strand Railway Company (underground); Brighton and Rottingdean Seashore Electric Tramroad (deviation of portion of authorised line, capital powers, &c.); Central London Railway (new lines, Wood Lane to Goldhawk Road, Uxbridge Road, Leadenhall Street, Old Broad Street. A subway from Surrey Street, Strand, under the Thames, terminating at a point 240 yds. east of Waterloo Bridge and 50 yds. south of the river front of the Victoria Embankment; subway from Bennet's Hill, Queen Victoria Street, under the Thames, at a point 50 yds. south of St. Paul's Stairs. Power to acquire additional land, generating station, &c.); Brompton and Piccadilly Circus Railway (extensions to Charing Cross and Walham Green); Metropolitan and District Railway Company (electric traction powers, agreements with other underground railways, &c.); Manchester and Liverpool Electric Express Railway Company (deviation of authorised railway, agreements with Salford Corporation, capital powers); Whitechapel and Bow (diversion, extension of time, further powers for adapting Whitechapel and Bow Railway for electric traction, &c.); London, Tilbury and Southend (electric working, generating station at Little Ilford, &c.); King's Road Railway (Putney extension, provisions as to electrical working); North-West London Railway (extension of time); City and Brixton Railway (abandonment of undertaking).

Electric Power Schemes and Miscellaneous.

North Metropolitan Electric Supply Company (further powers, extension of limits, generating stations, agreement with North-West London Railway Company); Garston and District Tramways and Electric Supply Companies (transfer to Liverpool Corporation); Kent Electric Power (new company, County of Kent); Medway and Thames Canal (new company to construct canal, establish generating station, and work traffic by steam, electric and other power); Gloucestershire (new company to supply power in the County of Gloucester); Leicester and Warwickshire Electric Power (new company to supply parts of the counties of Leicester and Warwick); Derbyshire and Nottinghamshire Electric Power Company (removal of restrictions as to erection of generating stations); Northumberland Electric Power (new company, County of Northumberland); South Wales Electrical Power Distribution Company (additional lands for generating stations).

INSTITUTION OF ELECTRICAL ENGINEERS.

Abstract of Inaugural Address by Mr. W. Langdon, President.

(*Delivered Thursday, November 21st.*)

During no period in the history of this country has commerce expanded, or the Arts, Science and Literature made such rapid progress, as during the past century, and especially so during the latter portion of that period. For the reason we have not far to seek.

With the advent of railways there sprang into existence a new life. A new era dawned, not only upon England, but upon the whole world. Manufacture and commerce grew, and England became more than ever the great engineering and commercial centre of the world.

Whether animated by those stirring events which accompanied the advent of railways, or not, their establishment was soon followed by the production of the need of the moment, a means of communication still more rapid—that first great application of electrical science, the electric telegraph, which, coming as a handmaid to the railways, was shortly to link together every land and people. 1850 saw England and the Continent of Europe joined. 1860 hailed the completion of that great enterprise which bound together in bonds of brotherly enterprise and unity—never, we hope, to be severed—the mother country and the great continent of North America.

To them, to their authors, England owes much of that greatness of which she may be justly proud; but, richly as they contributed towards the advancement of the world at large, deep as must ever be our debt to them and to those who have worked with them, we do not forget there are others whose brilliant achievements, if not at present so far-reaching in their beneficence, have greatly added to the lustre of the past period.

The telephone! Electric lighting! Wireless telegraphy! The various applications of electricity to chemistry and metallurgy! That great boon to suffering humanity, the discovery of the Röntgen rays, and lastly, but by no means the least, that outcome of Faraday's brilliant discovery of the relationship between the electric current and magnetism, the dynamo. As with wireless telegraphy, so with all these great discoveries, each marking a solid advance in electrical science, it is possible—nay, even probable, that we are still only treading on the fringe of something greater to follow.

Emblazoned on the annals of that period are names of which we, as Englishmen, may well feel proud—James Watt, Faraday, the Stephensons, Cooke, Wheatstone, Bright, Kelvin, Siemens, Swan, Wilde.

The past stands before us hallowed by the magnificence of the work accomplished. To us it is the gift of a century to improve; still to advance. Clamouring for attention, three subjects present themselves for urgent consideration:—

The overcrowding of the cities.

The advantages of electric traction.

The economical distribution of electrical energy.

No one can look around and remain insensible to the fact that our present mode of locomotion is destined in the near future to undergo great modifications. Our railways are becoming congested; the streets of our chief towns are year by year becoming more than ever blocked with traffic. Will the electric tramway deliver us from the latter difficulty? It is very doubtful. One would say that the streets of Glasgow were made for the electric tramcar, yet there are times when even there congestion is rife. What will it be in towns where the streets have not been laid out with the liberal regard to space which characterises the streets of that great city?

The question we have to approach is one of enormous magnitude. It is not merely one of business, or one of interest from an electrical point of view, but one which, inasmuch as it affects the moral and physical welfare of a great portion of the community, must sooner or later affect our national welfare. Year by year the difficulties consequent upon concentration of population become more apparent, and there exists no large town which would not welcome a more rapid mode of transit between its centre and its boundaries. How this is to be best accomplished is a question that must shortly call for grave and careful consideration, and especially so in this great city of London.

The electric tramcar—those moving palaces of light—has come to stay; but its field in the larger towns will doubtless be local traffic only, and with that it will scarcely cope. Traffic between the city and the more distant residential districts will require to be supplemented by a more direct, more rapid, and more extensive means of transit. If these surmisings are correct, and I believe I shall carry you with me in my conclusions, the relief we seek will, in respect of the larger towns, resolve itself into short suburban lines of railway radiating from one or more centres into the suburban districts, supplemented by a tramway service both in the city and in the suburban districts.

This, it appears to me, will prove the solution of the impending changes associated with city life locomotion, and in it will, I believe, be found the means of affording the pent-up population, growing more dense each year, that relief which is felt to be so necessary for the moral, social, and sanitary condition of the people.

But the question is one which goes far beyond the needs of city locomotion. Is it to the interest of the community that this ready means of communication should be limited to city or local areas? Have we not in it a means of supplementing the utility of our railway system, so that not only may populous villages be provided with easy and comparatively rapid means of access between each other and the neighbouring town, but also with the near railway station? It will be evident that to afford these facilities to rural districts alone would prove unremunerative. The point for consideration, then, is how can both municipal area and rural district be so served as to become a pecuniary success of such a character as to extend, as population increases, its advantages farther afield. There can be no question of pecuniary success accompanying the service of the town and its suburban area, but will this accomplish the full benefit desired? Even the suburban district of a town is by no means a fixture. As population increases, as districts become populated, as property increases in value, provided convenience for locomotion is established, so will the man of small means find it to his interest to go farther afield—even to adjacent villages. To afford free intercourse between town and village it is apparently desirable that the limitation imposed upon this means of communication should be restricted neither by boundary of town nor county, but that the basis of its extent and operations should be as nearly analogous as possible to that of the railway system. How this can best be accomplished, whether by joint enterprise, as with the railways, or by county or municipal enterprise, is a question which demands careful and far-seeing consideration. The convenience which a well conducted service is calculated to afford may be, to some extent, gauged by the announcement made on the occasion of the opening of the Southall extension of the London United Electric Tramways Company, to the effect that during the previous three months between 8 and 9 million passengers had been conveyed over the 7½ miles of electric route, then completed, at fares which did not amount on an average to ½d. a mile. To effect the common weal we must carry, to the farthest point remuneratively possible, the advantages which attach to this means of communication. By it will the resources of the provinces be more fully developed, and to the cottager be brought some of the advantages of the neighbouring town.

As one associated with our railway system, I ask myself in what way is this service destined to affect existing railway interests. The question is an important and a difficult one. In some instances, as has been the case with the Dublin, Wicklow and Wrexham Railway, it will undoubtedly make its mark on the railway revenue. In residential and in pleasure districts it will be most emphasised; but on the other hand, there is reason to believe that, in many districts, it will ultimately bring to the railways as many passengers as, in other respects, it takes from them. With increased facilities for intercourse will come the growth of local industries; the desire to see what others are doing; to keep abreast of competitors; to see the world. Trade and a love of travel will be stimulated by the facilities with which it is nourished.

I next turn to—

Electric Traction on Railways.

Is electric traction, which is being so rapidly developed in towns, to prove of service to our railway systems?

With the economies which might be fairly anticipated, were our main lines of railway operated by electrical energy instead of by numerous steam units as at present, I have, to some extent, dealt previously. The conservation of our coal; the greater purification of the atmosphere; the increased cleanliness of all things forming part of or bordering upon the railway, are natural advantages contributing to the welfare of the community at large.

If such a change could be effected at once, very many improvements in the mode of dealing with the traffic would appear feasible. Thus trains might be despatched at more frequent intervals—trains of lesser magnitude, capable of travelling at a higher rate of speed. It is obvious that this might also, to some extent, be accomplished by the steam locomotive, but to do so would mean a large increase in the number of engines and tenders, increased engine shed accommodation, and all attendant expenses.

In my official capacity it is not my duty to determine the speed at which trains should travel, but I cannot refrain from expressing my conviction that if it were possible to lessen the enormous difference which now characterises the speed of passenger and goods trains great advantages would follow. This can only be accomplished by lessening the mass of the goods and mineral trains, and bringing it more under the control of the brake—a result which probably will never be attained under the steam locomotive *régime*.

The advantages that would accrue from a facilitation of the traffic scarcely call for demonstration. Wherever the traffic is of a mixed character, involving the movement of trains at speeds varying from, say, 20 to 60 miles an hour, time must, even where scheduled time is observed, be sacrificed; and this loss must be greatly aggravated by the shunting of the heavy trains for the passing of those of a preferential character. The magnitude of the results arising out of this is not, perhaps, fully appreciated, for the existing mode of working the traffic scarcely admits of its consideration. But let us assume that in shortening these slow and heavy trains we are able to run them at a speed of not less than 40 miles an hour. As there would be no shunting for the reason that, with the exception of the express trains, all would be moving at about the same speed, it is clear we should practically double the capacity of the line, and that without increasing the labour charges, because, although we double the trains, we halve the time. The number of trains that would come under this category would probably be 75 per cent. of the entire number, and if the method would admit of the acceleration of the expresses also, it may well claim an increased capacity of 100 per cent. In other words, such a result would avoid that duplication of lines which is now unavoidable, and which is adding so many millions, year by year, to the capital account.

The operation by electrical means of the passenger traffic, as it is conducted to-day, would appear to present no difficulty, for if necessary, each carriage could be provided with the necessary motors for its propulsion; but to work a railway economically—to reap the full advantages of an electrical service—it is necessary that the entire traffic of the line, goods as well as passenger, should be worked by the same means. To work one class of traffic by electricity, and the other as at present, by steam units, although such a course is quite practicable, would involve a large increase in both capital and current charges; for the cost of establishing and operating electrical working for the passenger traffic would be very little less than it would be if dealing with the entire traffic, and there would still remain the cost attending that portion worked by the steam locomotive. Such a course appears to me impracticable. Therefore, in considering the initiatory stage of replacing the steam by the electric locomotive, we have to face the present condition of traffic—to deal with the trains as they are made up for the former type of motor. Assuming it were determined to test the possibilities of electricity on a given section of a line of railway, whatever that section might be—whether terminal or intermediate—the electric motor would require to haul the trains that might reach that section of the line as they were handed over from, or required to be carried forward by, the steam locomotive. It would, in fact, have to take the place of the latter, and do its work. It may be

said its capabilities to do this under all conditions have not been proved. It will, however, be clear that, assuming one electric locomotive incapable, there is no reason why two should not be coupled together in the same manner that steam locomotives are coupled. And in doing so, it is worth while noting that we should reap some advantage, for not only would it be possible for the two to be controlled by one man, or one set of men, but in distributing the weight over a great wheel base, we should, to that extent, reduce the impact on bridges and other structures over which the vehicles pass. The importance of this will be apparent when we realise that the total weight of a modern locomotive and tender loaded exceeds 100 tons; that of this weight some 34 tons is comprised within a wheel base of 9 ft. 6 in.; 26 tons and 24 tons each within 5 ft. 6 in. The tendency of the day is to increase the speed of passenger trains and the load of the goods and mineral trains, and to this end to employ larger and more powerful engines. In either case this course must involve greater stress on both permanent way and structural works; and to this extent it would appear that the two electric locomotives would be more acceptable to the engineer of the line than would the steam locomotive.

Much interest no doubt attaches to those railway conversion problems in hand here and in other countries; but assuming them proved—assuming them to be a success, would that success be deemed sufficiently definite to lead to its adoption on main lines generally? I scarcely like to commit myself to that opinion. I have full faith that our railways will be worked by electrical agency, but I want, with you, to look the probability squarely in the face. Every line of railway has its own mode of dealing with its traffic, and the character of the traffic is not the same on all lines. The only satisfactory way to prove the power of electricity to meet existing conditions is to impose upon it the work to be done. To do so on a suitably selected section of line would not be a great tax upon the resources of any one of our great railway companies, especially as it need not in any way, for the time being, derange the steam-worked traffic passing over that section of line.

Now let us look at the subject from another point of view. Electricity is credited with the power of accomplishing greater speed at a less cost than steam. An impression is abroad that greater facilities for rapid transit between large centres of commerce are a necessity of the day. If it should transpire that electrical propulsion is inapplicable to main line traffic as a whole—a conclusion which few would, even at the present moment, accept—it will unquestionably lead to the establishment between the chief commercial centres, of high speed passenger electric traction on independent lines. Communication between Manchester and Liverpool has, so far, been met—and one would say, amply so—by three lines of railway, all running a good train service, yet the construction of an electric line on the mono-rail system has received Parliamentary sanction. It is an object lesson, and tempts me to ask whether the requisite powers would not have been preferably granted to one of the existing lines of railway—a line of railway capable of interchange of stock and of connection with other lines—to employ electrical agency as its motive power, had powers for that purpose been sought.

Nothing could be more disastrous than that competition of such a character as, for instance, that thus initiated between Liverpool and Manchester should arise. Whatever success may attend competitive electrical enterprise in this respect must be, to some extent, prejudicial to the established systems. If the former should prove a pecuniary success, the reverse must be the condition of the latter. The capital invested in existing railways exceeds thirteen hundred million pounds. The wholsale depreciation of such a vast sum, the interest of which forms the income of numerous families and annuitants, would be little short of a national calamity. Naturally, were independent electric lines of railway to be established between the chief centres of commerce it would still leave a large mileage of the existing lines of railway unaffected by them, but is it from those parts of a railway system that the earnings come? The consequence must be, at the least, a decreased dividend, and probably in the end an enforced establishment on the older lines of a similar electric service between large towns.

The work of the railway engineer is to construct railways; and if the opportunity arises he will not be deterred from doing so by any consideration of the injury his work may inflict upon existing interests. The way to prevent him from doing so is to make it clear that there is no profitable need for any such addition; and this can only be accomplished by the existing systems showing that they are prepared to avail themselves of the same means—to afford as far as possible the same facilities and advantages as are to be derived from independent electrically worked lines.

It has been advanced that the existing lines of railways are unsuitable for higher speed; that the stock is cumbrous, and that the system is generally unsuitable. This has to be proved.

Railways have to face the fact that electricity as a motive power is before them. That if it is not applied to the existing systems—if they do not elect to avail themselves of it, it will come independently, and in competition with existing interests.

To attempt to approach the subject in a piecemeal fashion by dealing with a branch line here or there may be of service, but it can scarcely affect the main issue. While a small branch line is being converted, new lines between important centres will be constructed, and the passenger traffic between those centres will at least be split between the old and the new service. No one doubts the ability to apply electrical energy to branch lines, but many will doubt whether the traffic of a branch line can be so regulated as to form a continuous and remunerative service throughout the day. With main lines there can be no doubt of a regular demand, while most branch lines can with convenience be dealt with from the main line power station. Manifestly, however, if the trunk lines are eventually to be operated electrically, whatever may be done in relation to branch lines should be done with a view to harmonise with that system which will be ultimately employed on the main lines. I do not presume to indicate what that system may be—whether alternating or direct current—but it is clear that for main lines an overhead electrical service is inadmissible; and equally, to my mind, is a rigid or semi-rigid rate of speed. With a line carrying one class of traffic this latter question may not be so important, but on lines carrying a mixed traffic this cannot be so, for the power to vary the speed is a factor which must have an important bearing upon the working of the line. The speed, subject to a maximum limit, must be in the hands of the driver.

To those with whom may rest the privilege to establish electrically worked lines I would, with all respect, venture to say: Be careful that you do not retard that great work which sooner or later must invite attention. In the establishment of light high-speed point-to-point passenger lines, little difficulty may be encountered. It is not with them, however, that the interest of the country needs your aid so much as in the conversion of those lines which are already established. It is where competition of a fruitless character—fruitless in that it will not prove productive of a return to the shareholder of the new more than to the shareholder of the old—steps in that capital will be squandered.

The observations with which I have thus far troubled you are the result of careful consideration, inspired by a belief in the advantages of that new power which is before us. In the meanwhile the demands of a railway service have to be met by the means at our disposal. In it electricity is playing its part. In no way derogating from that useful service it has always rendered railway enterprise, its field is ever extending. In lighting, in local application of power for pumping, for lifting, traversing, and other purposes, its utility and adaptability, wherever it has been applied, is such as to create a desire for its extension. So far it cannot, however, be said that its full advantages are being realised. To reap these advantages it is necessary that the schemes under which it is employed should be more comprehensive, capable of dealing with a more extensive service. Probably the nearest approach to this condition yet attempted is the high tension generating station laid down by the Midland Company at Highgate Road, Kentish Town, which at present serves to light the Kentish Town, Camden Road, and St. Pancras passenger stations, together with the goods stations at Somers Town and St. Pancras, the day and night coal depôt at Somers Town, the Midland Grand Hotel, various cranes, traversers, and pumps. The output of this generating station was for the past year 2,081,129 kw., with a load factor of 40 per cent.

There are few railway companies who do not recognise the advantage of electricity for lighting their offices, goods yards, and depôts. In no instance is space or time more valuable than with a railway service. The ability to load and dispatch five trains where, under the old and inefficient mode of lighting, only four could be disposed of in the same time is equal to a saving of 20 per cent. in capital outlay for buildings and land, quite independent of questions of labour and rolling stock. I often doubt, although the advantage of electric lighting is so freely admitted, whether this great and important fact is realised. The North-Western, the Lancashire and Yorkshire, the Brighton & South Coast, the Great Eastern, the Great Western, the Great Northern, and other companies are reaping the advantages of their various installations. Still, there are fields of usefulness, embracing large economies, of which advantage is not being taken. These are to be found chiefly in relation to goods warehouses and in the large workshops of the companies. The value of electricity for workshop power has been so fully demonstrated in papers read before this and other institutions; it has been in so many cases applied with so much success, and attended with so much economy, that it is difficult to understand why it has not equally readily found a footing in railway workshops and warehouses. An object lesson is that of the Burlington railway shops at Hanibal, Minnesota. The entire shops are operated electrically, boiler house, lifts, turntables, cranes, &c., the total connected load exceeding 900 H.P.

The London and North-Western, the North-Eastern, and the Lancashire and Yorkshire Railway Companies have made the most use of electrical energy. In many instances each of these companies have, with evident advantage, replaced old and practically obsolete modes of operating cranes and tools by electric motors. The latter company operates its goods depôt at Oldham Road, Manchester, entirely by electrical energy—lighting, cranes, hoists, and capstans; the provender mill and warehouse adjoining being similarly operated. The new station at Bolton is to be similarly equipped for both passenger and goods work, and the signals and points of this station are to be worked electro-pneumatically. Many other portions of their system also employ electrical energy for various purposes. In their workshops considerable advantage has been taken of this source of power, always to good purpose. At Fleetwood a large elevator is similarly worked. The London and North-Western are preparing to work the whole of Crewe station electrically. The Lancashire and Yorkshire have also at their Lockwood and Castleton stations electric locomotives, the property of private firms, moving the traffic of those firms. These are worked from an overhead conductor.

That I may not labour you with many details I have, by the courtesy of the various responsible officers of the companies named, prepared and attached hereto a schedule of the chief work in this respect in operation on the principal British railways; and, similarly, I am also, by the courtesy of the electrical engineers of these companies, enabled to append details of block signalling and telegraph plant. Here it is only necessary to quote the chief features of these schedules, viz.: Arc lamps in operation, 7,182. Incandescent lamps, 85,683. Electric energy applied to power purposes, 10,527 H.P. In telegraphs total mileage of wire employed

on these lines for railway purposes approximates to 113,000; wires maintained for the Post Office, 86,000. Number of instruments, 158,286.

In telegraphy there is little to note otherwise than to record a continuous growth of system. As traffic and competition increases so increase the demands on the telegraph service. No form of instrument has, however, proved of greater service in working the trains than the telephone. It has, in fact, become indispensable on all the main lines.

In the interlocking of the electric block signalling instruments with the mechanical signals comparatively little progress has been made. The London and South-Western, and the South-Eastern—Chatham and Dover section—show the greatest advance in this respect.

Electricity as applied to the lighting of railway carriages is steadily making its way. Some 3,000 vehicles chiefly fitted with what is known as Stone's system are now running.

Why electrical energy has not made more headway on railways it is hard to determine. Possibly the ready provision of power which will be placed at the disposal of most railway companies by the establishment of those electrical power schemes which are now taking shape may prove a means to this end. The cost of laying down generating plant is undoubtedly one reason why the progress has not been greater.

(To be continued.)

THE ELECTRICAL WORKING OF RAILWAYS.

Paper on the "Working of Electric Railways on Main and Branch Lines," read before the Verein für die Förderung des Local und Strassenbahnwesens, in Vienna, by the President, Herr E. A. Ziffer.

(*Concluded from page* 734.)

The President of the Second Section, M. Jules Ludwigh, Member of the Upper House and President of the Hungarian State Railways, moved the following resolution:—

"That electric traction appears to be easily applicable to local lines, but on main line railways, unless in very exceptional cases, the problem of its employment cannot be regarded as solved, especially not if it is a question of conveying long and heavy trains."

He invited discussion on the two points of this resolution, each one to be taken separately.

M. Ernest Gérard, Chief Engineer and Inspector of Goods for the Belgian State Railways, desired that the two conclusions of the second part of the resolution, referring respectively to long and heavy trains, and to short and light ones, should each be discussed separately. He was of opinion that the latter part of the problem of electric traction is already solved, viz., the transport of light trains, but, on the other hand, he foresees great difficulty in conveying express trains weighing 250 to 300 tons by means of electricity.

M. G. Rigoni, engineer, and member of the Committee of the Association of Italian Tramways, drew attention to the good results achieved in Switzerland by the employment of polyphase currents.

M. Anvert pointed out, however, some difficulties in the application of such currents, which practically amounts to a system of constant speed, and makes it very difficult, if not impossible, to raise the velocity in case of need. M. Rigoni, on the contrary, attached no importance to these objections.

A discussion then took place on the subject of collectors, in which Messrs. Rigoni, Gérard, Mazen, Baudry (chief engineer on the Paris-Lyons-Mediterranean line), and M. Henry Cairo, sub-engineer of the Southern Railways, Adriatic network, took part. M. Rigoni recommended the use of overhead feeders for polyphase currents at high tension, but the other speakers contended that, seeing the results of former experiments, conducting rails were preferable, when once the speed exceeded a certain rate.

M. von Leber, Imperial Councillor of the Ministry of State Railways, also perceived certain objections to the direct application of currents at very high tension, which it seems are permissible in Italy. M. Rigoni replied to this, that in Switzerland, after a course of prolonged tests, public opinion had arrived at the conclusion that the use of high tension was sufficiently safe for ordinary requirements. M. Cairo added that in Italy the same decision had been attained, and he also gave some practical details of the precautions taken when employing high tension. This question gave rise to a somewhat lengthy discussion.

In practice it is of importance to take into consideration the generating expenses of electric traction. M. Solacroup, chief engineer of the Paris—Orleans line, wished to see the technical side of the question entirely separated from the industrial one, as the present difficulties of electric traction lie entirely in the direction of administration. This opinion was, however, vigorously debated by many of the members, and in any case it would be difficult to estimate, with any degree of accuracy, the exact cost of generating electricity for the purposes of railway traction. Another element, which would enter very considerably into the discussion, would be the exact importance of the traffic on the line which happened to be under debate.

M. Clérault, chief engineer of the Western French Railway lines, and M. von Leber, observed that it would be premature even to say that the question of electric traction on local lines was really solved. As regards the main lines, M. Campiglio, engineer and President of the Union of Italian local lines, declared that, in his opinion, electricity might lead to a new mode of locomotion, with lighter and more frequent trains.

M. Baudry, chief engineer of the Paris-Lyons-Mediterranean line, persisted in maintaining the importance of the employment which has hitherto been made of polyphase current, and drew attention to the various uses that can be derived from it.

The two sections of the Congress then arrived at the following conclusions, which were unanimously adopted, without modifications, by the entire assembly:—"The Congress affirms that the progress made in the use of electric traction warrants its introduction on certain railway lines, which exist under special technical and industrial conditions. At the same time the universal adoption of electricity as motive power cannot be regarded as a problem that is wholly solved, particularly in such cases where it is necessary to transport heavy trains with great rapidity over large areas."

We gather from these resolutions arrived at by a body of such eminent specialists in scientific and electrical branches, that their opinions in regard to the solution of the question of electric traction on railway lines were very divided. This was particularly so in the case of the French delegates, who have only very recently introduced electric traction by means of conducting-rails, or a third rail, for short distances, on some of their main lines. It was noticeable that these gentlemen did not display much enthusiasm for the cause of electric traction, a fact which I put down to their only having recently experimented with the same.

In reference to this point, I think that I must not omit to draw attention to the fact that on August 1st of last year (1900) electric traction was introduced on the Wannsee Railway (Potsdam Railway Station) between Berlin and Zehlendorf. I think it the more expedient on my part to give a few details on the subject, because mention has been made about it in the supplement to the report of the French railway officials from the western French lines, and from the Paris—Lyons—Mediterranean Railways; also the project of electric traction on the Wannsee line was discussed, among other electric railway schemes, not only here in this hall, but also in our Society's reports, and I myself found occasion to inspect the line in question during the course of last summer.

As far back as the year 1891 Mr. Bork, Director of Railways, had suggested the introduction of electric traction on main railway lines, and had brought forward in 1896 a proposal to make an experimental attempt on the Wannsee line. The causes which led to the selection of this particular line for trial trips were, firstly, the fact that on this railway, with its double line of rails and its great traffic, all the essential arrangements could be thoroughly tested; and secondly, because, by a previous understanding with the firm of Siemens & Halske, the cost of such an experimental line could be kept within bounds, this company having pledged itself to supply the necessary current direct from their power station in Gross-Lichterfelde, and also to put up the actual electrical equipment on the length of line between Berlin and Zehlendorf, 8 miles in extent. Further negotiations led to the signing of a contract, by means of which the generating of the current and the delivery of electrical fittings were left in the hands of the above-mentioned firm, in return for adequate compensation. In this way the proposed scheme for electric traction became a reality.

In Germany the first experiment was, therefore, made on one of the main lines, and it merits particular consideration on that account.

The energy necessary for working the trains on this line by electricity was generated in the power stations of the Gross-Lichterfelde tramways, which belong to Messrs. Siemens & Halske, and are situated at a distance of about 1½ miles from the railway. The current is a continuous one generated at a pressure of 750 volts, and it is conveyed by means of the overhead system of transmission on poles to the feeding points of the power mains, which are situated at the same height as the Steglitz railway station at a distance of about 4½ miles from Berlin.

In order to regulate the considerable fluctuations in the load, an accumulator battery has been connected to the power mains at each of the termini chosen for that portion of the Berlin-Zehlendorf line, which is to be worked by electricity. These batteries consist of 311 and 318 cells of type "E. S. 44," made by the Berlin Accumulator Manufacturing Company, and have a maximum charge of 500 amperes and a capacity of 814 ampere-hours for one hour discharge and of 1,138 ampere-hours for three hours. In this way three power stations unite in producing the current—Gross-Lichterfelde, Berlin and Zehlendorf—and their work is divided in such a manner that the Berlin battery delivers the greater part of the current required between Steglitz and Berlin, the dynamo supplies the rest and the Zehlendorf battery more or less according to the condition of its load. If, on the contrary, the train is running from Steglitz to Zehlendorf then the *rôles* of the two batteries are reversed.

The live conductor for each direction consists of a special well-insulated rail. It is, therefore, the so-called system of the third rail which is employed, and it is arranged in such a way that it runs parallel with the other two rails in the centre of the space between them, and at a height varying from 12·6 in. to 54 in. from the upper edge of the rail and the middle of the track respectively. For this purpose old railway lines of about 8·2 sq. in. section have been laid flange downwards, the joints united by strong copper bonds which transmit the current. The live rails rest on double insulators placed at intervals of 4 to 5 yards, and are themselves fixed to the sleepers by means of iron supports firmly attached to bolsters, so that when repairing the track the electric conductors should maintain their correct height and position. In order to protect persons employed on the railway from any accidental contact with the live rails, wooden guards have been fixed and run along both sides of the live rail for the whole length of the line.

The current is carried back through the ordinary rails, whose powers of conducting have been greatly increased by means of copper bonds at the joints.

The electric train consisting of 29 axles, weighs about 220 tons, is able to carry 410 passengers, and can attain a speed of 34 miles per hour on the level; its normal rate is 28 miles per hour.

The third-class motor carriages, with three axles situated at either end of the train, each contain a driver's box, so that when the direction of the train is altered at the terminal stations, there is no necessity for shunting the motor-carriages, and in this way time, labour and power are saved. Between the two end motor-cars are placed eight local line carriages, four second-class carriages, and four third-class carriages of the usual type; so that the entire train is, as it were, enclosed between two motor-cars, of which the one pulls, and the other pushes, and both work uniformly, so that neither jolting nor jerking ensue. Throughout the entire train an electric main runs underneath the body of the carriages, by means of which the collectors attached to the axle-boxes of the two motor-carriages, and, if need be, also to those of some of the carriages in between can be coupled in parallel; there is also a second electric main for connecting the two controllers.

The collector-leads run to the switchboard, from whence the current traverses the measuring instruments, the automatic switch, the fuses, the resistance and the motors, and from there back into the rails.

Every motor-carriage has three motors mounted on the axles, which are attached to the body of the carriage by means of springs; the strength of the starting current should not exceed 200 amperes each.

In this way all gearing has been avoided, and the distinct advantage is gained that there is no noise, and there are no toothed wheels to be worn away by constant friction. The normal output of the six motors amounts to 600 H.P., but at starting it can rise to 1,000 H.P., in which case the current at 600 volts pressure reaches the considerable figure of 1,200 amperes, which, to illustrate it by a comparison, is equivalent to an expenditure of force equivalent to 15,000 16-C.P. lamps.

The collectors are equipped with movable vertical iron shoes, which trail along the rail. The regular braking of the train is done by the Westinghouse brake, but experiments will eventually also be made with electric braking. In the place of the ordinary steam whistle a compressed air whistle is in use. The lighting of the cars and of the signal lights at the end of the trains, in use after dark, is in each case effected by means of electric lamps fed direct from the mains. Up till now the train has been heated by steam, for which purpose a boiler has been fitted to one of the motor carriages, but the idea or heating by electricity instead is under consideration.

The exterior appearance of the train differs from that of ordinary trains only in the one respect, that there is no steam locomotive at the head of it.

Till now only six timed trains run between Berlin and Zehlendorf, as it was considered expedient for the present to limit the number, owing to the novelty of the whole installation, and the fact that extensions and repairs were to be expected on the line. In the course of time the number of trains running in each direction will be increased to 15. Precautions have been taken so that in case of a breakdown in the electrical arrangements, a locomotive will always be standing in readiness to take the train on.

In regard to the results of the experiments and the experiences acquired, it may be noted that the starting is invariably effected in a quiet and smooth way, and that the facts ascertained, and the notes taken during the trial trips have all been collected according to a specially prepared plan, and will form a safe starting point for further developments, from a technical and financial point of view, in the introduction of electric traction on main line railways.

Experimental trips in electric traction will be made on a large scale on the military railway between Mariendorf and Zossen under the control of the Studiengesellschaft für Elektrische Unternehunngen, in Berlin. (Berlin Society for the Study of Electrical Undertakings.)

Messrs. Siemens & Halske, and the Allgemeine Elektricitäts Gesellschaft, in Berlin, each supply one motor carriage, for which the specification is as follows:—The carriages are to be 25 yards in length, they are to contain 60 seats, and to be 70 tons in weight; a polyphase current of 12,000 volts pressure is to be supplied to them, which is to be converted in the carriages themselves by means of transformers to 1,000 volts pressure. In these experiments the chief question is that of speed. An expenditure of from 1,000 to 2,000 H.P. would probably be necessary in order to achieve the desired speed of 120 miles an hour.

We should also like to draw attention here to the experiments which have lately been made with polyphase currents by the firm of Ganz & Co., in Buda-Pesth, to which we already referred in the November number of our *Proceedings*. We may assume, therefore, that through the experiments already made, and through those still to be made, particularly, however, by the undertaking on the Wannsee Railway, a new basis has been laid for the introduction of electric traction on a larger scale on the main line railways; and quite a new era is opening for railway managers in the way of reforms in transport, in tariffs, in the speed of the trains, and in the saving of working expenses, all of which factors appear likely to be conducive to the opening up of further channels of employment for the new motive power on railway lines. The conversion of steam traffic into electric traffic should be of especial importance, however, for city and suburban lines, where the frequency and rapidity of the trains, the absence of smoke and noise, ought to be an inducement not only to the passengers themselves, but also to the inhabitants.

All the practical results arrived at in the experiments cited by us above will undoubtedly be of use in the adoption of electric traction on our own projected City line; and in the interests of public welfare it is our sincere desire that the same may be inaugurated even if only experimentally, as soon as possible.

THE DESTRUCTIVE AND LETHAL EFFECTS OF HIGH-PRESSURE * CURRENTS. †

By Dr. MARGARET A. CLEAVES.

There are delivered from the high-pressure line of a big transmission plant at night, glowing blue with the energy that is streaming off into the dielectric, perhaps thousands of kilowatts to distant transformers, which may serve to light a whole city or furnish power to operate a street railway system. The one result or the other obtains according to the conditions of the conducting circuit; but, in both instances, it is energy which is delivered at the terminals, and which, by its expenditure, produces the different phenomena instanced.

In the application of an electric current to the human organism, whether administered therapeutically, encountered accidentally in the pursuit of one's avocations, or whether applied with intent to kill (electrocution), energy is expended within the tissues of the body, causing physiological change, pathological lesion, or destruction of life. The phenomena produced, whether for life, disability, or death, depend not alone upon the initial pressure, but upon all the conditions of the conducting circuit, *i.e.*, resistance electrical and vital, as well as position, superficies, and nature of contacts. A recognition of the oneness of this energy, whether of low or of high pressure, whether continuous or alternating in its direction, as well as the precise and definite laws under which it acts, conduces to an intelligent appreciation of the varying phenomena produced by its expenditure. A study of the action of an expenditure of energy from a high-pressure source or from a lower pressure, but capable under suitable conditions of producing injurious or destructive effects, involves an analysis of:

(1) Experiments made upon animals with a view to determine the cause of death;

(2) Of such accidents as occur in the use of industrial currents;

(3) Of the phenomena observed in the electrocution of criminals.

There is a considerable array of experimental work to be drawn from, going back to the time of Nollet, but much of it was conducted in a crude and unscientific manner, and is of little save historical value. The most careful and scientific work has been done within the past eleven years; and the conclusions reached by the different experimenters referred to in the following analysis point in almost every instance to a uniform action and set of conditions, although only interpreted by Prévost and Battelli and Cunningham.

Under the second head the evidence is not so conclusive as in the first and third. In accidents due to electric currents—by reason of the fact that they are accidents and occur unexpectedly—the precise conditions of the conducting circuit, as well as the phenomena pertaining to the mechanism of injury or death, are rarely observed with scientific accuracy. Still, considerable data have been accumulated, which, with the data of experimental work and those secured from the electrocution of criminals, suffice to further an intelligent analysis of the subject.

Under the third division—the electrocution of criminals—every opportunity is afforded to note exactly all the conditions of the conducting circuit, the pressure, the superficies, position and nature of contacts, the precise measurement of current in amperes, the time, the resistance, the power of watts, and the work or total expenditure of energy in joules. The opportunity also exists, if it could be taken advantage of, for obtaining definite, detailed, and scientific information as to how and when death occurs; as to consciousness and sensation; and also whether resuscitation would be possible by the immediate application of some special method; and it has been suggested that if the law recognised the right of science to have present a trained observer, with the privilege of using the necessary physiological apparatus in order to record graphically the phenomena which take place both during and after the passage of the current, as well as to make a careful study of the post mortem findings, the result would be of incalculable value in determining the mechanism of death in man.‡

The conclusions arrived at as to the manner in which death takes place in man are determined by inference from experimental work, from the accidents which take place in the electrical industries, and from electrocutions; but the data would be more absolute and trustworthy if procured in the way above alluded to, and yet at the same time no harm would be done to the individual suffering the penalty of the law.

Before entering upon a detailed account of experimental work, it would be well to consider the electrical conditions necessary to the production of injurious and lethal effects:—

1. What is to be understood by high-pressure currents in relation to lethal effects—*i.e.*, what voltage is necessary to the production of fatal results?

* In every instance in which authorities quoted have used the word "tension" in relation to an electric current, the writer has substituted "pressure," in order that the terminology may be exact.

† *Handbook of the Medical Sciences. (U.S.A.)*

‡ Cunningham: "The Cause of Death from Industrial Currents."

2. Is it a matter of pressure—*i.e.*, volts alone, or is it a matter of current—*i.e.*, amperes as well?

3. What influences the latter, the pressure only, or do high-pressure currents from position and nature of contacts act as medium or low-pressure currents?

An analysis of the experimental work (which will be considered more in detail from the physiological side later on) shows that currents of varying pressure have been used to produce a lethal effect in the same species of animals, while varying pressures are required for different species of animals.

For example: Houston and Kennelly used pressures of from 690 to 1,250 volts alternating (experiments on dogs):* Bleile used from 50 to 100 volts alternating (experiments on dogs);† Kratter used 1,500 volts alternating (experiments on dogs, rabbits, and guinea-pigs);‡ Cunningham employed continuous currents of 115 volts pressure from lighting mains, and 124 volts from a battery of accumulators (experiments upon dogs);§ while Prévost and Battelli conducted their experiments with both continuous and alternating currents and pressures varying from a low pressure of 120 volts to a medium pressure of from 240 to 600 volts, and high pressures of from 1,200 to 4,800 volts.‖ They used in their experiments dogs, guinea-pigs, rabbits, and rats. Bokenham and Jones, in their experiments made upon cats, reported the current, viz.: 0·5 ampere, but not the pressure;¶ Tatum used from 0·1 to 1·3 ampere; while Oliver and Bolam give only the physiological results obtained**—to which reference will be made later on—but neither the pressure nor the current.

Kratter found that rabbits often survived pressures which proved fatal to dogs 10 times the size, and Cunningham found it possible instantly to arrest the cardiac function in a very large dog—such as a Newfoundland—with a current of but 0·3 ampere; while the hearts of small, shaggy terriers, although considerably affected, not only withstood repeated shocks of 0·45 ampere, lasting from 10 to 80 seconds, but quickly recovered from a shock of 0·7 ampere applied for 2½ seconds. In common with those of Prévost and Battelli, his experiments show that certain species of animals, frogs and turtles, do not succumb to currents of low pressure.

Prévost and Battelli established that with a pressure of 120 volts (alternating currents, contacts good—*i.e.*, one upon the head, the other upon the limbs) death resulted in certain animal species, while others (for example, rats) escaped without harm.

Kratter found that a short exposure to an alternating current of 1,500 volts did not always prove fatal to rabbits and guinea pigs, while others succumbed presenting typical symptoms.

With currents of high pressure, Prévost and Battelli found that 1,200 volts (the contacts being good—*i.e.*, the one upon the head and the other upon the limbs) could kill all animals by inhibition of the respiratory centre; but that the pressure of the current and the duration of the contact should increase with the size of the animal in order to inhibit the respiratory centre. A rat, for example, succumbed to a pressure of 600 volts for one second, while a rabbit required 1,200 volts for two seconds. A dog of smallest size required 2,400 volts for three seconds, while a dog weighing 8 kgm. resisted a shock produced by the passage of a current of 1,200 volts prolonged for five seconds.†† Nor is the pressure fatal to animals, when acting as a high pressure, necessarily fatal to man.

Of equal importance with the pressure is the position, superficies, and nature of contacts. The latter may be of a material which is a good conductor, but by reason of imperfect contact they may act as a poor conductor, thereby increasing the resistance and diminishing the amperes; the same will be true if the contacts are dry instead of moist. With the skin well wetted with salt solution the resistance is lessened; and with diminution of resistance there is an increase in the amperes. In such a condition of the skin a greater amount of current is delivered to the tissues, producing a fatal result; whereas, if the skin had been dry and able to perform its function as an insulator, the resistance would have been so great as to have limited the flow in current below the lethal dose. A well-insulated contact also serves to increase the resistance and to minimise the current.

The superficies governs the distribution of current on the one hand, or its current density on the other. With a large square-inch area of contact, the greater the current diffusion; with small superficies the greater the current density, within a localised area. These are factors of great importance, and must never be lost sight of when considering physiological effect.

The position of contacts is of the greatest importance and largely influences the result. All experimental work, as well as what is observed at electrocutions, proves that fatal results ensue much more quickly when the contacts are so placed as to bring the heart, which is the vulnerable organ, on a line which unites the two electrodes—*i.e.*, directly in the conducting path; as, for example, on the head and calf of the leg. When they are placed on the head and forelegs, or in the case of man (electrocuted criminals) on the hands, a much greater pressure is necessary to destroy life. This is because the heart is not in the direct pathway of the current. When both contacts are placed upon the head, higher pressures are required to produce fatal results. Here, by reason of the skull, there is increased resistance; and, as the evidence shows that stronger currents, *i.e.*, greater amperage (see Houston and Kennelly, pressure 690 volts, R. 1,200 ohms, current 6 amperes, dog not killed), are withstood, the pressure must of necessity be proportional. As will be seen further on, the action of the current is different in a head contact than when the heart is included in the circuit. These facts all point to the chest directly over the heart, and to the dorsal region, as the better places for the contacts in electrocutions; but, as it is desirable that consciousness should be annulled at once, the posterior contact could be made to include the cervical spine, medulla oblongata, and the head.

Duration of contact, or time, is another important element. An instantaneous contact with a high pressure current may be encountered with impunity, but a fatal result will ensue if an application of several seconds—5, 10, or more—be made; or, if a high pressure current be applied for an instant of time and repeated fatal results may ensue.

As to the amperage of a lethal current, it is not definitely known, but all the evidence obtained from experiments on animals and accidents with industrial currents show that it is very small—probably much under 1 ampere. In the application of the death penalty, as practised in the State of New York, the strength of the alternating current passed through the body of the criminal is usually 7 or 8 amperes. In experimental work the species, weight, and age of the animal have influenced the result, and the age of man, as well as the vital resistance in both man and animals, is a factor that must be considered in determining the lethal dose. In his experiments Cunningham found that young, well-nourished, and hardy dogs bore a stronger current than those older and ill-nourished, but that the size and weight seemed to bear no relation to the minimum current.

The nature of the pressure, whether continuous or alternating, is not without its influence. Cunningham found that alternating currents of moderate frequency, intermittent and coarsely pulsatory currents, were able to produce fibrillary contractions of the heart much more readily than a non-alternating or a continuous current. Tatum found alternating twice as fatal as continuous currents, but when the animal experimented upon was under ether the difference was much less marked. This would point to the influence of the powerful muscular contractions in the production of lethal effects; as, under the influence of anæsthesia, there would be a condition of general muscular relaxation which would tend to minimise this action. D'Arsonval believed that greater danger lay in accidental contact with a high pressure continuous E.M.F., because of the electrolytic phenomena which accompany the action of the current. The living body, in reality, is not a homogeneous conductor, and the polar action is produced not only at the points of entrance and departure of the current, but at the surface of each different tissue crossed by the current. This is an opinion—*i.e.*, as to the action of the current—which is shared by other physicists, although, as will be seen, Tatum concluded that there was nothing in the evidence obtained to show that any action on the blood was of the nature of electrolysis.

From the physiological action of high frequency alternating currents of high potential as administered therapeutically, as well as from the experiments of D'Arsonval, Elihu Thomson and Tesla,* with currents from 100,000 to 200,000 volts, with a frequency of 10,000 periods per second, it would be expected that fatal effects would occur in inverse ratio to the frequency—*i.e.*, that a low frequency, or periodicity, is more fatal to life than a high. The higher the frequency the greater the current which can be delivered to the tissues of the body without injury.

It is of interest here to note that alternating currents of high frequency, applied to the exposed heart, produce an increase in the number of beats and fibrillation does not occur; and the oscillatory currents of high potential very materially hasten the restoration of the co-ordinated heart beat in dogs in conjunction with the perfusion of the coronary vessels with defibrinated blood.†

The evidence clearly shows that high pressure currents are not along fatal—not even necessarily fatal; that low pressures—95 or 96 volts, and 115 volts, alternating current—are sufficient to cause death; and that while ordinarily pressures under 200 volts are not to be regarded as dangerous to life, and those over 500 volts as certainly dangerous, everything depends upon the conditions of the conducting circuit. In electrocution, to ensure instantaneous and painless death, currents of high pressure are of necessity chosen.

Accidents in the electrical industries are not unduly frequent as compared with the accidents in other industrial fields; not because the pressures employed would not prove fatal under appropriate conditions, but because these conditions are but infrequently fulfilled.

(To be continued.)

* Houston and Kennelly: "Death by the Alternating Current."
† Bleile, A. M.: "The Cause of Death by Electrical Shock."
‡ Kratter: "Lesions of Fatal Electrical Currents."
§ Cunningham: "The Cause of Death from Industrial Currents."
‖ Prévost and Battelli: "The Mechanism of Death by Electric Currents in Man."
¶ Tatum, Edward: "Death from Electrical Currents."
** Oliver and Bolam: "The Cause of Death by Electric Shock."
†† Battelli, Frederic C.: "The Mechanism of Death by Electric Currents in Man."

* Thomson, Elihu: "Effects of High Frequency Electrical Discharges Passed Through the Body." Tesla, Nikola: "Alternating Currents of High Frequency and High Potential."
† Cunningham: "The Cause of Death from Industrial Currents."

THE SILVERTOWN PATENT CONNECTOR FOR ELECTRICAL TESTING.

We have received specimens of the Silvertown patent connector, which will, we think, commend itself to electricians as a great improvement on the one hitherto employed.

This connector (figs. 1, 2 and 3), designed by Mr. J. Rymer-Jones, chief electrician of the Silvertown submarine electrical department, has the advantage of being adjustable within wide limits, and it, therefore, takes the place of several sizes of the connector in ordinary use. It can connect together for electrical testing two wires of the same, or widely different, diameter, or the ends of two or more small wires may be secured in the same hole without the risk of any one of them being loose.

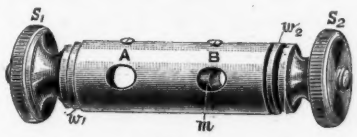


Fig. 1.

The conductors to be connected together are inserted into the holes at A and B near to the two ends of the connector, and are secured in position by turning the milled-head nuts, s_1 s_2, so as to draw their sliding pieces, m—through circular holes in which the wires entering at A and B respectively pass—in a direction at right angles to the conductors, and thus grip them tightly.

As the wires are encircled partly by the connector tube and partly by the slides, the surface of contact is broad and much more satisfactory than in the ordinary form of connector, in which contact is made by the end of its screw stem pressing, with more or less directness, against a solid conductor, or burrowing into or between the wires of a strand.

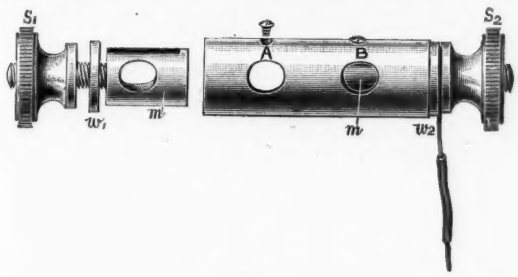


Fig. 2.

The slides, m, are limited in their movements both ways; the one limit being when the hole in the connector is entirely closed by the slide (B, fig. 2) and the other limit being when the holes in both parts exactly coincide, admitting freely the conductor (A, fig. 1.)

Another advantage possessed by the Silvertown connector is that it has also two *spare* screw terminals. Thus: After securing their conductors as explained, either s_1 or s_2 may be temporarily unscrewed to permit another wire (say to the testing apparatus) to be hooked on to the slide spindle between the nut and its washer, at w_1 or w_2, and then screwed up again tightly. These additional connecting points are not available in the ordinary form of connector in use.

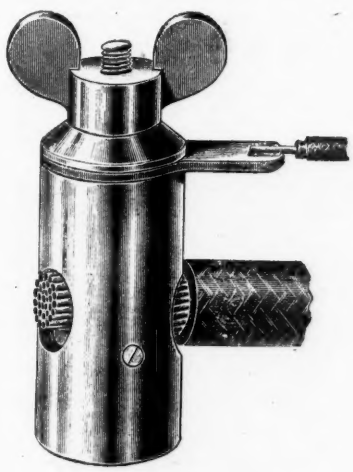


Fig. 3.

Moreover, if the wires to be joined together for testing be of such small diameter that the connector slides might cut or damage them, and thus increase the resistance at the points of contact, the slides, m, may be drawn out to their full limit by s_1 and s_2, and these nuts then become two ordinary single terminal screws capable of clamping very fine wires at w_1 and w_2 without injuring them (fig. 2).

The connector is made in two sizes, as shown *full size* in figs. 1 and 2, viz.:—For small conductors of 0·144 in. diameter (No. 9 gauge) and under, class No. A. 1125; for cable conductors of 0·212 in. diameter (No. 5 gauge) and under, Class No. A. 1126.

Another *single slide* connector (shown *half size* in fig. 3) having a stout washer with a lug to which the lead wire is intended to be soldered, is made for electric light conductors 1·000 in. diameter and under, Class No. A. 1127.

The first two connectors, A. 1125 and A. 1126, have milled-head nuts, while the connector A. 1127 for electric light conductors has a fly-nut to secure a firm grip and press all the wires of a strand tightly together so as to improve their lateral contact.

A convenient and reliable terminal screw is also made on the same principle for voltmeters, ammeters, and other electrical apparatus. This terminal will grip firmly with its slide contact a stout conductor, or two or more small wires, without fear of one of them being loose. Between the nut and its washer there is also the additional means of attachment, as in the "connector," especially suitable for very small wires.

DESIGNING OF CONTINUOUS CURRENT DYNAMOS.

By RANKIN KENNEDY.

Years ago I thought this subject had been thoroughly thrashed out, but it seems from the remarks on the papers read at the Glasgow Engineering Congress that there is still some doubt as to how designs for sparkless machines should be calculated out. Now, as a matter of fact, there is nothing easier than to design a sparkless dynamo or motor, and that, too, without the almost innumerable nostrums and fakements which have been patented with a view to obtain sparkless collection.

A few square acres of papers have been written and read on the subject of commutating and collection in continuous current dynamos, and still we have sparking, heating, and destruction at the brushes and commutators. The solution of the problem of sparkless commutation is not so much a scientific question as one of costs.

The specification for making commutation sparkless is briefly put in a few words: "Put enough stuff in the machine." Of course, the stuff must be of the right sort, and in the proper place.

I shall here only put the matter elementarily, as the scheme is the thing, not its actual working out.

The E.M.F. given out by a dynamo, or taken by a motor, depends on three factors:—

A = the speed.
B = the magnetic flux through the armature (total).
C = the number of turns or bars in the armature winding.

A is always given in value.

B and C are left to the discretion and skill of the designer, and on the proportioning of these two factors depends whether the machine shall be a success or a failure.

Other things, of course, also determine the constitution of the machine, but B and C are the primary factors—

$$\frac{B}{C} = y$$

and the greater the ratio, y, the better the machine.

In order to deal numerically with small numbers, I prefer Kapp's units, taking 15 Kapp lines per sq. in. as approximately equal to 14,000 C.G.S. lines per square centimetre at the same value for μ, so that those who cannot use Kapp's formulæ may work it out in C.G.S. units.

In two tests upon a small but well-proportioned machine—

(1) A = 1,000.
B = 450.
C = 150.

$$\text{Ratio } \frac{B}{C} = 3;$$

No sparking, perfect working.

(2) A = 1,000.
B = 340.
C = 200.

$$\text{Ratio } \frac{B}{C} = \frac{340}{200} = 1{\cdot}7.$$

Results, violent sparking, heating, failure. Any proportion of C to B below the ratio as 1 is to 3 is dangerous in a bipolar machine, hence a good bipolar machine must have a very heavy magnetic circuit and few turns or bars on the armature, and these bars must be multiplied or very heavy, thus introducing air space difficulties. It is, therefore, better to adopt multipolar construction to obtain a large total flux, and a small number of turns on the armature; this is done by employing 3, 4, 5 or 6 pairs of poles and coupling the armature bars in parallel, a practice which is becoming universal.

In these cases of multipolar machines, my rule can be applied by taking the total flux, B, between any one pair of poles, and the number of armature turns or bars between the centres of the two poles, as C; the ratio should not be less than $\frac{B}{C} = 3$.

A sparking collection simply means a weak magnetic flux, and an armature with too many turns of winding, the winding being piled on to make up for want of magnetic flux. Dividing the armature winding into many sections, say, one turn, or two turns, per section, also reduces sparking and trouble.

Of course, the ratio 3 to 1 only applies when Kapp lines are used; it would become, in sq. in. C.G.S. lines, $\frac{2,700,000}{150} = 18,000$ to 1 approximately.

I have reports from owners of machines built on these principles 10 and 12 years ago, which are now working as well as ever, and have never sparked.

The simple rule for improving any design which tends to commutating troubles is to reduce the armature turns of winding and increase the magnetic flux. This means increased cost on field magnets, and hence the tenacity with which designers hold on to cheap fakements which are supposed to assist in suppressing the troubles.

Another way of arriving at the proportion of C to B without taking the fearful figures required for C.G.S. induction calculations is to take the ratio between the sectional area of the magnetic circuit and the number of turns of winding on the armature; thus in the machine referred to, the section is 30 in. fully, or 200 sq. centimetres, giving $\frac{200}{150} = 1{\cdot}33$ as the ratio of area in cm. to number of armature turns.

A still better machine would have the ratios $\frac{B}{C} = \frac{500}{130} = 3{\cdot}84$.

That is to increase the section of the magnetic circuit from 30 to 33·3 in., and reduce the armatures turns from 150 to 130, total flux 500 Kapp lines. There is not much mystery about designing machines for sparkless collection.

Followed logically, this principle leads to the unipolar dynamo, in which there is collection but no commutating. A unipolar dynamo has hitherto been considered as only fit for low pressure and large currents, it being considered impossible to put conductors on the armature coupled in series with each other. But this can be done, and a unipolar dynamo made for 500 or 600 volts at any reasonable speed.

In a unipolar machine the magnetic flux can be easily increased to a very large value; there is no reversal of magnetism, nor of current; no necessity for laminations, and, of course, no commutating; a simple device recently discovered renders this long-sought machine possible; when fully developed and protected, it will be illustrated and described.

PHYSICAL SOCIETY.

Ordinary Meeting held November 22nd, 1901.

Prof. S. P. Thompson, President, in the Chair.

Prof. W. Cassie read a paper on "Multiple Transmission Fixed Arm Spectroscopes;" also a paper on "The Measurement of Young's Modulus."

A paper entitled "Notes on Gas-Thermometry, Part II.," by Dr. P. Chappuis, was read by Dr. Harker.

The Society then adjourned until December 13th.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

22,682. "Improvements in the construction of carbon filaments for incandescent electric lamps." J. A. Calantarients. November 11th.

22,710. "Improvements in telegraph and telephone systems." L. Cerebotani and C. Moradelli. November 11th. (Complete.)

22,711. "Improvements in apparatus for reversing motion transmitted by electric current impulses through a single line to a body with the aid of motive power acting in a definite direction." L. Cerebotani and M. Bernstein. November 11th. (Complete.)

22,742. "An automatic fork to facilitate the bringing into contact of trollies, or other means of making contact as used in connection with electric trams of the overhead system, with the overhead leads." F. J. Bretherton. November 11th.

22,746. "Improvements in or in connection with winding machines for wire ropes, cables and the like." W. B. Brown. November 11th.

22,760. "Improvements in moulding glass vessels suitable for accumulator cells." E. Muller. (Ladiges, Greiner & Co., Germany.) November 11th.

22,808. "Improvements in means for working signals and points on railways electrically." E. W. Timmis. November 12th.

22,851. "Improvements in or relating to electric signalling for railways." T. W. Gornall. November 12th.

22,888. "Improvements in and pertaining to electric railways." W. L. Wise. (The Maschinenfabrik Oerlikon, Switzerland.) November 12th.

22,898. "Improvements in the lapping heads used in electric cable-making machines." E. A. Claremont and J. B. Hyde. November 12th.

22,899. "Improvements in wattmeters." W. du Bois Duddell and T. Mather. November 13th.

22,921. "Improvements in selective systems for electrical communication." S. A. Reed. November 13th. (Complete.)

22,9 7. "Improvements in electric relays." Siemens Bros. & Co., Limited, and G. Forrest. November 13th.

22,938. "Improvements in electrical apparatus worked by the axle of a vehicle." H. J. J. Hummel. (Partly communicated by J. H. L. Onken, Germany.) November 13th.

22,953. "Improvements in or relating to electro-magnetic cut-outs." E. L. Joseph and G. Gardner. November 13th. (Complete.)

22,978. "Improvements in electric meters." Evershed & Vignoles, Limited, and S. Evershed. November 13th.

22,983. "Improvements in cut-outs for Nernst lamps." E. G. Sheppard and Nernst Electric Light, Limited. November 14th.

22,984. "Improvements in series resistances for use with electrolytic glow bodies." M. Solomon, S. Gowan and Nernst Electric Light, Limited. November 14th.

22,985. "Improvements in the manufacture of heaters for incandescent lamps of the Nernst type."

22,990. "Novel or improved insulating composition for electrical purposes, and a method of applying the same." J. W. Sankey. November 14th.

22,997. "Improvements in reversing gear for internal combustion or electric motors for propelling vehicles or traction engines." C. Burrell & Sons, Limited, and W. C. Wilson. November 14th.

23,030. "Improvements in or relating to apparatus for automatically switching electric current on or off, turning gas or water on or off, and the like." J. J. Stockall, Jun. November 11th.

23,038. "Improvements in or in connection with electric arc lamps." F. W. Branson. November 14th.

23,046. "Improvements in or relating to electro-magnetic cut-outs." E. L. Joseph and G. Gardner. November 14th. (Complete.)

23,054. "Improvements in electrical measuring instruments." R. Ziegenberg. November 14th.

23,059. "Improvements in and relating to electricity meters." W. M. Mordey and G. C. Fricker. November 14th.

23,097. "The electric lamp exchanger for expeditiously renewing lamps in chandeliers without using a ladder or scaffolding." J. Woods. November 15th.

23,114. "Improvements in controllers for electric motors." F. C. Newell. (Date applied for under Patents, &c., Act, 1883, Sec. 103, April 18th, 1901, being date of application in United States.) November 15th.

23,115. "Improvements in windings for electrical machines." B. G. Lamme. (Date applied for under Patents, &c., Act, 1883, Sec. 103, April 17th, 1901, being date of application in United States.) November 15th.

23,116. "Improvements relating to the regulation and distribution of electric currents." B. G. Lamme. (Date applied for under Patents &c., Act, 1883, Sec. 103, April 17th, 1901, being date of application in United States.) November 15th.

23,131. "An improvement in surface-contact for electric traction." G. F. M. Cornwallis-West. November 15th.

23,153. "Improvements in or connected with electrical demand or rebate indicators." A. Wright and the Reason Manufacturing Company, Limited. November 15th.

23,166. "Improved devices for use in electric wiring." J. A. Robertson. November 16th.

23,214. "Improved manufacture of a material for incandescent electric lamp filaments." Siemens Bros. & Co., Limited. (Siemens & Halske, Actien Gesellschaft, Germany.) November 16th.

23,215. "Improvements in electrical accumulators." V. Cheval and J. Lindeman. (Date applied for under Patents, &c., Act, 1883, Sec. 103, April 22nd, 1901, being date of application in Belgium.) November 16th. (Complete.)

23,225. "Improvements connected with incandescent or open electric arc lamps." L. C. H. Mensing. November 16th.

23,230. "Improvements in and relating to electric batteries." K. Szwede and M. Norvicki. November 16th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1900.

1,148. "Improvement in troughs for electric cables." Siemens Bros. & Co., A. E. Foster, and H. J. Nott. Dated January 18th, 1900. Conduits or troughs for conductors are formed with internal projecting portions, and with lids thickened in the centre to form fitting shoulders. The projecting portions form a raised support for the conductor, and also a spigot joint.

1,133. "Improvements in or relating to incandescent electric lamps." A. J. Boult. (Communicated.) Dated January 18th, 1900. Incandescent lamps.—A bulb is partly blown in an open mould shaped to produce straight prismatic grooves in the lower part; the bulb is then rotated to curve the grooves, and finally is blown to a spherical ellipsoidal, or other form in a smooth mould, made in halves. The upper part of the bulb is provided with a reflecting coating, or with a close fitting separate reflector.

1,147. "Improvements in electric motors for rotary tools and the like." P Jensen. (Communicated.) Dated January 18th, 1900. Relates to the construction of electric motors for operating rotary tools, especially such as are used in dentistry.

1,167. "A new or improved adjustable suspension device for electric lamps." A. J. Fabre. Dated January 18th, 1900. A lamp and shade are hung by a conducting cord, which is passed through a flange and round small and large parts of a drum free to rotate in a casing weighted by shot, so that the weight of the casing and drum balances the pull of the lamp on the larger part of the drum. If the lamp is raised the casing descends, and the drum takes up some of the cord, while if the lamp is pulled down, cord is unwound from the drum, and the casing ascends.

1,168. "Registering apparatus and circuits for telephone measured service." J. E. Kingsbury. (Communicated.) Dated January 18th, 1900. Relates to apparatus for charging for telephone services by means of registering or counting mechanism, which is not operated until the calling station is placed in communication with the station called. The apparatus is arranged on the central battery system.

1,276. "Improvements in or relating to electric chain link-welding machines." A. J. Boult (Societe E. Giraud et Cie, France.) Dated January 20th, 1900. Relates to an electric welding machine for chain links. The chain, ready for welding, is passed over a carrier disc adapted to bring the horizontally-placed links in succession between the dies and under the welding terminals. The disc is mounted on a spindle and is driven intermittently by a toothed segment on the driving-wheel. The terminals are mounted on arms worked by cams and springs. The welding dies are pressed outwards by springs and inwards by cams on the main shaft which act upon rollers on their stems. The finishing dies are worked by a cam and a rack and pinion respectively. The alternate links are welded by a second passage through the machine.

1,407. "Improvements relating to electric traction on the conduit and road contact system." R. Brown. Dated January 23rd, 1900. Electric railways and tramways on the conduit and road contact systems with mechanically-operated switches. A wire rope or the like carried by brackets on the vehicle, moves in a shallow conduit alongside one rail, and depresses a roller-ended spring or counter-balanced levers so that their arms complete the circuit from the main conductor either through the lever and rope, or through separate road contact studs and a skate collector to the motors.